ACID RAIN

HEARING

BEFORE THE

SUBCOMMITTEE ON ARMS CONTROL, OCEANS, INTERNATIONAL OPERATIONS AND ENVIRONMENT

OF THE

COMMITTEE ON FOREIGN RELATIONS UNITED STATES SENATE

NINETY-SEVENTH CONGRESS

SECOND SESSION

FEBRUARY 10, 1982

Printed for the use of the Committee on Foreign Relations

U.S. GOVERNMENT PRINTING OFFICE
92-838 O WASHINGTON : 1982

3381-34

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ACID RAIN

WEDNESDAY, FEBRUARY 10, 1982

United States Senate,
Subcommittee on Arms Control, Oceans,
International Operations and Environment of the
Committee on Foreign Relations,
Washington, D.C.

The subcommittee met at 10:10 a.m., in room 4221, Dirksen Senate Office Building, Hon. Larry Pressler (chairman of the subcommittee) presiding.

Senator Pressler. I shall call the subcommittee to order. It is the Subcommittee on Arms Control, Oceans, International Operations and Environment.

I was asked this morning why a Senator from South Dakota would be interested in acid rain and the status of bilateral negotiations with Canada on this problem. Let me say that in South Dakota we have excellent air quality and I am concerned about a situation in which agriculture could be affected by acid precipitation.

I was told that South Dakota's air quality are so good tests for sulfur dioxide and nitrogen oxide pollution are not conducted because these pollutants are so negligible they do not register on the scale. However, that does not mean we should not be concerned about what might happen in the future.

There is a potential threat to South Dakota's soil and water quality from acid rain pollution unless vigorous steps are taken soon.

Proposals for power production through coal-burning plants in Wyoming, Montana, and North Dakota could result in severe pollution in my part of the world. Not only would sulfur dioxide emissions increase substantially if these coal-burning powerplants increase, deteriorating our nearly pristine air quality, but agriculture, land, lakes, and fish stocks could fall prey to the effects of acid rain.

Senator Glenn is unable to be here today, but he has requested that his prepared statement be inserted in the record. Without objection, it will be inserted at this point.

[Senator Glenn's prepared statement follows:]

Prepared Statement of Hon. John Glenn

Mr. Chairman, although I was unable to attend your "acid rain" hearing, I appreciate the opportunity to comment for the record on this issue.

Since the problem of "acid rain" was first observed in the United States activity in the scientific community, both in government sponsored studies and in industry, has accelerated. Title VII of the Energy Security Act established an intensive 10-year program to identify the causes and effects of acid precipitation. Its task force hopes to develop a comprehensive research plan. The Memorandum of Intent, approved jointly by the United States and Canada, recognizes the transboundary implications of this issue and the need for a definitive understanding of it. In addition to government efforts, the electric utility industry, through EPRI, has sponsored and coordinated research over a five year period. The coal industry is also involved. In Ohio, a task force created by the Governor recommended creation of an acid rain office within the OEPA air pollution section. This office is now in operation and has recommended increased coal washing. A bill to mandate this action is before the Ohio General Assembly.

These studies have enabled us to add to our knowledge concerning some aspects of the acid precipitation phenomenon. However, we have not determined conclusively what sources most contribute to the problem. The role of Midwest sulfur emissions in promoting Northeastern acidity is far from proven fact. In testimony before the Senate Environment Committee in November 1981, Volker Mohnen, Director of the Atmospheric Sciences Research Center stated that there was currently no scientific basis for establishing a source-receptor relationship for acid rain. Preliminary evidence in other studies, such as the one at University of Rhode Island's Center for Atmospheric Chemistry, indicate that acidic deposits in the Northeast are local rather than Midwestern in origin.

Even if subsequent data should show that Midwest industry is a significant contributor, substantial reductions in SO_2 have already been achieved under existing regulations, most notably the Clean Air Act. The emission standards adopted for new coal-fired powerplants, compared to current standards, will reduce sulfur dioxide emissions by 55 percent, nitrogen oxides by 20 percent, and particulates by 70 percent. These standards require removal of at least 70 percent of the sulfur from all coal, regardless of its total sulfur content, and 90 percent from high sulfur coal.

Further controls envisioned by acid precipitation control legislation recently introduced in the U.S. Senate would have an economic and human impact of staggering proportions on Ohio and other Midwestern States. For example, Peabody Coal Co. estimates that 7,826 direct mining jobs, 11,739 indirect mining jobs and a total of 19,565 jobs would be lost to achieve emission standards required by one pending bill. Estimates place total employment loss in the 12 producing States at approximately 180,000, with 243,461.8 tons of coal production displaced. Ultimately, the consumer will shoulder the increased costs of compliance and suffer the economic consequences of increased unemployment. When additional regulations could cause disruptions of this magnitude, the need to respond quickly should not overshadow the duty to respond responsibly.

I support continuing, and expanding, existing research efforts designed to increase our understanding of this difficult problem. I believe further research is essential before we impose regulations.

Senator **Pressler**. At this point I call on my distinguished colleague, Senator Daniel Patrick Moynihan.

STATEMENT OF HON. DANIEL PATRICK MOYNIHAN, A U.S. SENATOR FROM NEW YORK

Senator **Moynihan**. Mr. Chairman, you could not be more generous.

If I can submit a written statement for the record I would like to do so, and then summarize my thoughts in this matter. Thank you for holding this hearing, it is exceptionally relevant to your subcommittee and to the Congress.

There are several things to be said here at the outset. The first is, we are dealing with one of the continued themes of the 20th century, a subject of particular interest to your subcommittee, which is the impact of technology on society.

It is one of those chain impacts that we are dealing with here where fixing up problem X leads to problem Y. With acid rain it is probable that a good deal of the environmental legislation that led to dispersing air pollutants into the high atmosphere in the middle west got them in the wind streams that take them into the northeast and beyond. It is probably not fully understood but it comes under the heading of "normal science." Mr. Chairman, that is, you put resources to work and you get answers in a fairly predictable way, but you have to do it.

We have just begun to do it. We passed legislation in 1980 that set up a 10-year cycle of research on the subject. Senators Mitchell, Dodd, and I have legislation pending before the Environment Committee that would begin to move more directly toward specific control actions on the grounds that while we not know all we would want to know we know enough to act at this point. But, sir, that is self-evident and scarcely worth taking your time to relate.

What I would like to speak to you about is the essentiality of this issue with respect to American foreign relations with the single most important country with which we have relations. It is so easy to think of Canada as a neighbor and somehow subsumed under the same set of concerns that we have, and whatever we are doing they are doing, tracking each other in one way or another. That is not so, not at all.

The first thing to recognize is that there are many important countries in the world with which we have relations, but none is more important to us than Canada.

We have incomparably the longest border with Canada, from the Atlantic to the Pacific. Canada is in between two of the parts of our country, it borders the 48 American States on the north and Alaska on the south. Our relations with Canada have changed our whole position in the continent. No care could be too great to see that they continue to be as good as they are.

Nothing is more risky than to assume that because they have been in such good shape, they must necessarily continue to be so.

Now, sir, the Canadian people and the Canadian Government and governments—because their provincial governments are very strong indeed—are of the view that the United States is pouring poison into their lakes and does not care. They are not far from being wrong in this matter.

If I could first offer you a gratuitous analysis of national character which is probably hideously wrong but at least it is my impression. Lakes matter to Canadians in the way sunsets matter to westerners. I mean, they really are the symbols of their great country. They count them to a degree of baffling precision. They will tell you that in Ontario there are 211,413 lakes, something like that.

They will also tell you of a recent sample of 2,600 lakes in Ontario. They found 48 percent of them beginning to be sensitive to acidity, something entirely new. Those lakes matter to Ontario, and to all the Canadian Provinces in ways that we would be very foolish to underestimate. They are Canada, they are wilderness, they are the freedom that Canadians associate with their frontier and with their nature.

They have begun to sense this assault, coming in part from their own sources but principally from us. They sense that we do not care.

If I could just give you one anecdote. In May 1981 the State University of New York at Buffalo—it has a Canadian-American Relations Center—was holding a 2-day conference on acid rain. The Canadians were invited, of course, and they came. They came in a delegation headed by the Secretary of State of Canada. It happened I was speaking at lunch and was there, and there was the Canadian

Secretary of State for External Affairs Mark MacGuigan, half a dozen aides, several other high-ranking officers of the Canadian Government. But there was not so much as a vice consul from the United States there to greet them.

Secretary of State Haig was busily enroute to a meeting in Rome of NATO Ministers. Mr. MacGuigan was going to be sitting next to him at that very same meeting in Rome but thought it more important to stop off in Buffalo on the way.

I went through a series of frantic phone calls to the White House and found that there was a member of the White House staff who was going to be there but found he was busy Saturday moring. There was somebody at the State Department who had been thinking about it, but it did not seem very important to him.

We finally got an apology by way of cable, but that was all. Do not suppose that this was not noticed by the Canadians who were too polite to speak of it, but the journalists who recorded it for television across the nation were not.

Just another point to give you a sense of the importance of the acid rain issue to the Canadians. I held hearings on acid rain in Albany, N.Y., on July 1 of last year.

July 1 is National Day in Canada, Canada Day or Empire Day, depending on your political convictions. The Ontario Minister of the Environment, Keith Norton, was in Albany, N.Y., testifying before our subcommittee when on July 1 he would normally be making speeches and addressing his constituents. It was more important for him to be in Albany.

Now, we have got to pay attention to their concerns. We have got to note the realities of the subject. Acid rain will kill a lake.

I have flown around in the Adirondacks—that is the only geographical area of which I can speak with some authority—and I have seen the lakes. It is one of the interesting things that lakes get prettier when they die. They are a beautiful Caribbean blue. That is because there are no nutrients in that water, it just reflects the sky and the sun. When you see an Adirondack lake that is blue and perfect, that means there is not a fish left in it. There is a real probability you have acid rain.

Major work on this matter has been done at Cornell University. There is a real probability that flora is affected and tree growth is restrained. Anything that alters the environment this drastically is going to have consequences. They are just beginning to be appraised, consequences in agriculture, in forestry.

I do not want to tell you more than you want to know on the details of this, sir. I just want to say the thrust of my proposition to you is that you are altogether right to see this as an international matter. We must deal with the Canadians on it. We are dealing at the technical level, but this has not in any way been raised to the agenda of international concern by the Department of State or the White House.

It just might interest you, sir, that when the President visited Ottawa on his first state visit to Canada, evidently the White House staff was baffled. There were protesters all over Ottawa and they were protesting something called acid rain and our fellows had arrived with briefing books on everything but they had never heard of acid rain.

I do not think they have it in California. They are beginning to get it in Hawaii, and you know where from? Japan.

Senator **Pressler**. From Japan, all that distance.

Senator **Moynihan**. Yes, and it is beginning to appear in the Southern United States coming out of the industrial complex in the Southwest.

But as a problem with Canada in our relations it is one which very much deserves your attention and I think it is more than characteristic of you to be holding these hearings and I want to thank you for doing so.

I will answer any questions you might have.

[Senator Moynihan's prepared statement follows:]

PREPARED STATEMENT OF HON. DANIEL PATRICK MOYNIHAN

I am pleased to be here today and I wish to thank Senator Pressler for the opportunity to testify on the issue of acid rain and United States-Canada relations on the subject. Acid rain has long been an issue of concern to me as a New Yorker—New York being one of several states dramatically affected by acid rain—but it also concerns me because a good part of the environment of North America is threatened by this phenomenon. It is an international as well as national issue.

Canada has some.million square kilometers of "acid sensitive terrain" within its borders according to the National Research Council. The Province of Quebec indicates that more than 1,300 lakes in that province are currently "acid-stressed." In Ontario, 48 percent of 2,600 lakes that have been sampled have been found to be very sensitive to acid rain. In the Adirondack region in New York State some 200 lakes and ponds have lost all fishlife as a result of increased levels of acidity.

In 1979, based upon my concern that Federal research on acid rain was under funded and lacked coordination, I introduced the Acid Precipitation Act of 1979 (S. 1754) which became law as Title VII of the Energy Security Act of 1980 (P.L. 96-294). As a result we now have an Interagency Task Force on Acid Precipitation that is embarking upon a coordinated national assessment program. The Task Force's comprehensive plan and first annual report are due to be released shortly.

While we still do not know all there is to know about the acid rain phenomenon the information we do have leads me to the conclusion that if we do not act, and do not act soon, we run the risk of causing irreversible damage to our environment. Most notably a recent report prepared by the National Research Council concluded: "Continued emissions of sulfur and nitrogen oxides at current or accelerated rates, in the face of clear evidence of serious hazard to human health and to the biosphere, will be extremely risky from a long-term economic standpoint as well as from the standpoint of biosphere protection."

As such on October 6, 1981 I introduced S. 1709, the Acid Precipitation Control Act of 1981, which would establish a reasonable program for controlling acid deposition. Under S. 1709 the 31 States bordering on or east of the Mississippi River would be declared an Acid Rain Mitigation (ARM) region. Within that region, states would be required to mandate substantial reductions in sulfur dioxide emissions—a principal cause of acid rain—between now and December 31, 1991.

Specifically, under terms of the legislation, emissions of sulfur dioxide within the region would have to be reduced by approximately 6.7 million tons per year in addition to the 1.5 million ton reduction already required by the Clean Air Act. An estimated 22 million tons of sulfur dioxide emissions are poured into the atmosphere each year within the ARM region. Over 70 percent of these emissions come from fossil-fuel burning powerplants operated by utilities.

The amount of emission reduction in each state within the ARM region would be equal to an 85 percent decrease in actual sulfur dioxide emissions from the largest powerplants in the State. "Largest powerplants" in the bill are defined as those which emit over 50,000 tons of sulfur dioxide per year at rates greater than 3 pounds of sulfur dioxide per million British thermal units (Btu).

States would be given the right to amend their own air pollution control implementation plans, now required by the Clean Air Act, to meet the goals set forth in my bill. Moreover, States would be allowed to trade emission offsets with other States in the ARM region so that a regional strategy for controlling acid rain could emerge.

If States fail to meet the goals set forth in S. 1709, then the Administrator of the U.S. Environmental Protection Agency would be instructed to develop and enforce an appropriate plan for meeting the targets.

On the day I introduced S. 1709 representatives from the Canadian Government testified before a subcommittee of the House of Representatives about their nation's serious concern about acid rain. The international aspects of this problem can not be taken lightly. Acid rain is a matter that deeply troubles our northern neighbors. Those of us who truly value the friendship of Canada must treat this issue with the utmost importance.

On July 1, 1981 I conducted a Clean Air Act hearing in Albany, New York. Despite the fact that it was Canada Day, the national holiday celebrating the independent dominion status of Canada, the Minister of the Environment from Ontario, Keith Norton, his deputy and a number of staff members were present to discuss how that province was approaching the acid rain problem. Some very interesting and enlightening data were presented and strong statements about the need for action were made.

I have also discussed the issue with both Prime Minister Trudeau and John Roberts, the Canadian Minister of the Environment, and I know how strongly they feel. In March 1981 when President Reagan traveled to Canada he was greeted by protest signs reading "Stop Acid Rain."

Acid rain has gained widespread attention within Canada. It is a bi-partisan issue and one of genuine interest to many of that country's citizens, making it one of the most important bilateral issues facing the United States and Canada today.

It is important to point out that the Canadians are taking action to limit their emissions in an effort to control acid rain. The Province of Ontario is requiring a significant reduction in sulfur dioxide emissions at the INCO, Ltd, smelting operation in Sudbury, Ontario. The Province has also directed Ontario Hydro to undertake an emissions reduction program that will require a capital expenditure of $500 million and annual operating costs of $90 million. In December 1980 the Canadian Parliament unanimously passed amendments to their Clean Air Act giving the Canadian federal government authority to deal with transboundary air pollution. Additional recommendations for Canadian action are contained in a recent report from a parliamentary Sub-committee on Acid Rain entitled "Still Waters." That document quotes from John Stuart Mill:

"Men and governments must act to the best of their ability. There is no such thing as absolute certainty but there is assurance sufficient for the purposes of human life."

All of this leads me to express my concern over the status of United States and Canada negotiations concerning transboundary air pollution. I hope that this subcommittee can help to sort out the direction that those negotiations are taking and to determine if the United States in engaging in them with as much seriousness as I believe the Canadians are displaying.

I am familiar, as are the members of this subcommittee, with how the negotiations were begun. In 1979 I was a co-sponsor of a resolution (S.R. 465) calling upon the Secretary of State to enter into negotiations with the Government of Canada to establish a framework for resolving transboundary air quality problems. This resolution was transformed into an amendment to the fiscal year 1979 State Department authorization bill.

In July 1979 the United States and Canada announced intentions to enter into a cooperative agreement on transboundary air quality and on August 5, 1980 signed a Memorandum of Intent (MOI) to establish a formal process for negotiating a bilateral agreement to achieve the necessary reductions in transboundary air pollution. Five technical and scientific work groups were established to assist in preparations for the negotiations by analyzing information on a variety of issues related to the long range transport of air pollutants, in particular acid rain. Initial reports from each working group were to be presented on January 15, 1981. This occurred on schedule. But since then there has apparently been slippage.

Phase II of the working groups' reports were scheduled to be completed in May 1981. It is my understanding that two of the working groups' Phase II reports have been completed but have yet to be released formally in the United States. As a result the MOI process seems to have slowed down and the final reports from the working groups that were due to be submitted by January 1982 have not been completed. May I suggest that this is something that the Subcommittee might want to look into.

I am concerned about the progress of MOI negotiations in part because of an event I experienced last May. I was scheduled to speak at an acid rain conference in Buffalo, New York, on May 2 sponsored by the Canadian-American Center of the State University of New York at Buffalo. Upon arriving in Buffalo I learned that the Canadians attending the conference, including the Canadian Secretary of State for External Affairs, Mark MacGuigan, were expressing serious concern about the lack of participation by any high-ranking Administration official from the United States. I was distressed to learn of this situation. I was informed that an associate director of the Office of Management and Budget had at the last moment cancelled his appearance. The Canadian Secretary of State thought the issue important enough to stop in Buffalo yet the United States sent no one.

I am told that tne United States and Canada will be meeting in a MOI negotiating session on February 24th and it is my hope that the attitudes brought to the table by our representatives would be positive and forthcoming.

Senator PRESSLER. I have a couple of questions for you. However, I want to recognize Senator Mitchell. We are looking forward to his remarks very much.

Let me first say that you are absolutely right on our relationship toward Canada. As a member of the Foreign Relations Committee I have tried to enter into dialog every chance I can with the Canadians with respect to issues of mutual concern.

What recent measures have New York officials taken to control emissions in their jurisdiction which could have significant effect on the acid rain problems in sensitive areas?

Senator MOYNIHAN. This is the point of the techonolgy, Mr. Chairman. What you have is the long-distance transport of pollutants, particularly sulfur dioxide. They get up into the high wind stream and run into rain conditions.

The actual atmospheric science of it all is not settled, but the basic models are known. This particular problem of Ontario, Quebec, originates in the Ohio Valley, basically.

Senator PRESSLER. Are you aware that Ontario Hydro burns unscrubbed coal for export while clean hydroelectric power is available and being purchased by them even now at 80 percent of the costs of this coal fired generation?

Senator MOYNIHAN. I am aware that they have their own problems in Ontario, but I think they have done a good deal about them. Specifically, some of the problems that New York has does, in fact, originate in Canada. The biggest particular problem in Sudbury—I think it is Sudbury—it has a large nickel smelter. They are cleaning that up.

Ontario Hydro has been producing its share of problems, but they are working at solving them. They do not dissemble, they do not come around saying this is just a problem we Americans make, they say this is a problem that the Canadians make, too. On this count I give them high grades.

Senator PRESSLER. As part of any treaty with Canada, would you want all surplus unscrubbed coal fired generation that is not necessary for system reliability stopped? Would you want necessary facilities to be replaced over time with cleaner facilities as a condition in any treaty?

Senator MOYNIHAN. Mr Chairman, I do not want to set conditions for treaties I am not going to negotiate. I think we have to look to our own problems. Senator Mitchell will tell you of his legislation, of which I am a cosponsor. We have a range of options before the Environment and Public Works Committee.

I think what we want to do is go into a negotiation with clean hands. Mr. Chairman, you may not want a treaty on this. I am not sure this is the sort of thing that you get into treaty obligations with. I think this is something for executive agreements and continuous monitoring, and this joint activity—the kind we have done with the Canadians on a dozen things. This is not a subject which can be dealt with once and then resolved.

My personal judgment is executive agreements establishing joint monitoring arrangements and agreements about emission levels are preferable, but here may be a case or a treaty. Treaties are the subject of the Committee on Foreign Relations. My subject is simply acid precipitation. I leave diplomacy to you, sir.

Senator **Pressler**. Thank you very much.

I point out again that the Izaak Walton League of America is represented here by an individual from South Dakota. Not only do the Canadians worry a great deal about lakes, we have many lakes in South Dakota as you do in New York, and we are very concerned. It is something that we must worry about and I commend you for being here.

Senator **Moynihan**. Thank you, Mr. Chairman. Senator Mitchell, now there is a man from a State with some lakes. Thank you very much.

Senator **Pressler**. Senator Mitchell, I did not see you sitting here or I would have called you to the witness table. I am very glad to have you because I know you have proposed legislation in this area and have many other meetings this morning.

So, without a lengthy introduction I will call upon you for your opening statement.

STATEMENT OF HON. GEORGE J. MITCHELL, A U.S. SENATOR FROM MAINE

Senator **Mitchell**. Thank you Mr. Chairman, for your invitation to appear before this committee. I do have a lengthy opening statement which I will summarize and ask that the full statement be inserted in the record.

Senator **Pressler**. Without objection it is so ordered.

Senator **Mitchell**. Mr. Chairman, it is appropriate and timely that you and your colleagues should be examining the foreign relations aspects of the acid rain issue. Both the domestic and international implications of failure of the U.S. Government to address the problem are sobering.

I am here today to emphasize the high risk of American inaction in this area. Senator Moynihan has already eloquently described the importance of United States-Canadian relations, I will not repeat him and merely say that I associate myself with his remarks that Canada is the most important country with which the United States deals.

That is especially the case with respect to my own State. The relationship between the people of Maine and our Canadian neighbors is an open and friendly one. Indeed, we in Maine think of it as a special relationship. That is because many Maine citizens—up to 25 percent of our population—are of Canadian ancestry. Our economies are interdependent and they are heavily and directly dependent on a healthy renewable resource base. We share many values and attitudes that come from living in a sparsely populated but still healthy natural environment.

North America is confronted with an environmental problem which has not been completely defined but which is already of substantial dimensions. Acid precipitation is first and foremost an environmental problem in the United States and Canada, but it is not a conventional problem capable of easy solution. Acid rain defies all of the premises on which current air pollution policies rest.

It is confined to no single State or nation. Its effects occur great distances from its sources. Its damage is silent and often invisible to the naked eye.

But the environmental damage already documented on this continent is very real and very great. In literally hundreds of lakes in the Northeastern United States and Eastern Canada animal and plant life no longer exists. Some 212 lakes in the Adirondack Mountains of New York and 140 lakes in Ontario are without fish. An additional 48,000 Canadian lakes are seriously threatened.

There are volumes of statistics, Mr. Chairman, let me just say a few more: 107 rivers in Pennsylvania show increased acidity and in 58 percent of them there has been a decline in the number of fish species present. Fishing tallies dropped 30 percent in the lake district north of Quebec City between 1970 and 1978; 56 percent of lakes tested in Quebec have been found to be extremely sensitive to acid deposition, and 17 percent were actually acidified.

In Maine, the acidity of lakes has increased eightfold over the last 40 years. Native brook trout no longer reproduce in Maine's high altitude lakes. The first fishless body of water in Maine, Chairback Pond, has recently been documented. Tributaries of at least five Atlantic salmon rivers are sufficiently acid to jeopardize young fish.

Similarly, in Nova Scotia, salmon are extinct in 9 rivers and 11 others in the Provinces are threatened.

Destruction from acid precipitation may not be limited to aquatic resources. There is evidence to suggest that North American forests may also be at great risk as acid deposition increases.

The United States and Canada who share a common stewardship of one of the richest land masses in the world are faced with a potential environmental disaster. Yet, the American and Canadian responses have been diametrically opposite. The Canadian Government considers the acid rain issue one of its most pressing domestic and international problems which must be addressed by commitments to reductions of sulfur emissions in both countries now.

The current American administration, by contrast, takes the position that not enough is known about the problem and that years of more study are necessary before any corrective action can be called for in this country.

The position taken by the President and the Environmental Protection Agency has serious international implications. The large quantities of acid rain generated in the United States and exported to Canada are straining United States-Canadian relations. Unless the United States reduces its large contribution to Canadian acid rain levels, the historic relationship between our two countries will be sorely tested.

Prime Minister Trudeau has made Canada's concerns known directly to President Reagan. The President responded that he is committed to solving the problem.

The United States is also bound by the memorandum of intent, a written document entered into with Canada in August of 1980. We have committed to combat transboundary air pollution by the development and legislative enactment of domestic air pollution control strategies and by vigorous enforcement of existing laws.

There is no evidence to date that this U.S. Government is living up to these commitments.

I have stated my resolve to fulfill these commitments in the form of a bill introduced last fall. The administration's opposition to my legislation or to any other meaningful legislation in this area is a direct contradiction of the President's commitment to Prime Minister Trudeau and to the written obligation of this Government under the memorandum of intent.

It is therefore, Mr. Chairman, incumbent upon the legislative branch of government to fulfill America's commitment to action. My bill will accomplish this.

In my written statement I describe the bill in considerable detail, Mr. Chairman, I will not repeat it here. In the interest of time I would like to make just one comment, anticipating one of the criticisms that will be made of my bill.

It is frequently said that it costs too much. Well, I want to emphasize one point: My bill does not create a new cost, it simply reallocates an existing cost that is now being exacted from the people of Canada, the people of Maine, the people of the rest of New England, in the form of irreparable damage to our natural resources.

Industries in the Midwest would be required to pay for cleaning up the sulfur emissions that they now export freely to the Northeast. They would be required to bear the burden of their activities instead of simply reaping the benefits of those activities. There is no incentive, there will be no incentive for the midwestern industries to clean up as long as they can dump their pollution in Maine, Canada, and the other New England States.

In closing, Mr. Chairman, I emphasize the high risk of the administration's policy of inaction on acid rain from an environmental and economic perspective and with respect to our relations with Canada. Every action of this administration to date indicates an unwillingness to take any action to reduce sulfur emission.

The Canadian Government, on the other hand, has made a good-faith effort to live up to its commitments in the memorandum of intent. Their actions should be an incentive for similar good-faith efforts by the United States, but it is clear that this will not occur unless the Congress acts.

Canada has already required the International Nickel Co. to reduce substantially by 1913 sulfur emissions at its Sudbury smelter. Ontario Hydro, the publicly owned Provincial utility, has been ordered by the Provincial government to reduce its sulfur and nitrogen oxide emissions by 43 percent by 1990.

From the perspective of the Canadians it has become quite obvious that the current American administration intends to do everything in its power to weaken the existing Clean Air Act, to weaken its implementing regulations, and to ignore even the international implications of such a course of action.

It is little wonder that acid rain has become a major bilateral issue. The position of this administration is an affront and insult to our most important allies, the Government of Canada. In my regular contact with officials of the Canadian Government at both the Federal and Provincial levels I continue to assure them that I and many of my colleagues in the legislative branch of this Government share their commitment to action.

I urge all of the members of this committee to join with me to implement our existing commitment to Canada through the enactment of the legislation that I propose.

Thank you, Mr. Chairman.

[Senator Mitchell's prepared statement follows:]

PREPARED STATEMENT OF HON. GEORGE J. MITCHELL

Thank you, Mr. Chairman, for your invitation to appear before this Committee.

It is indeed appropriate and timely that you and your colleagues should be examining the foreign relations aspects of the acid rain issue. Both the domestic and international implications of failure of the United States Government to address the problem are sobering.

I am here today to emphasize the risk of American inaction.

As a Senator from Maine, I have cause for alarm for a number of reasons.

Much of my State forms a peninsula into Canada just as southern Ontario does into the U.S. midwest. Our relationship with our Canadian neighbors is an open and friendly one. I think that people of Maine, perhaps more than any other State, can lay claim to a special relationship with our Canadian neighbors. This is because many of our citizens have Canadian ancestors, because our economies are so heavily and directly dependent on a healthy renewable resource base, and because we share many of the attitudes that come from living in a relatively sparsely populated and still reasonably healthy, natural environment.

North America is confronted with an environmental problem which has not been completely defined but which is already of substantial dimensions.

Acid precipitation is, first and foremost, an environmental problem in the United States and in Canada. But it is not a conventional problem capable of easy solution. Acid rain defies all of the premises on which current air pollution policies rest.

It is confined to no single State or national boundary;

Its effects occur great distances from its sources;

Its damage is silent and often invisible to the naked eye.

But the environmental damage already documented on this continent is very real and very great.

In literally hundreds of lakes in the Northeastern United States and eastern Canada, animal and plant life no longer exist—some 212 lakes in the Adirondack Mountains of New York and 140 lakes in Ontario are without fish. An additional 48,000 Canadian lakes are seriously threatened. The statistics go on and on——

> 107 rivers in Pennsylvania show increased acidity, and in 58 percent of them there has been a decline in the number of fish species present.
>
> Fishing tallies dropped 30 percent in the lake district north of Quebec City between 1970 and 1978.
>
> Fifty-six percent of lakes tested in Quebec have been found to be extremely sensitive to acid deposition, and 17 percent were actually acidified.
>
> In Maine, the acidity of lakes has increased eightfold over the last 40 years. Native brook trout no longer reproduce in Maine's high altitude lakes. The first fishless body of water in Maine, Chairback Pond, has recently been documented. Tributaries of at least five Atlantic salmon rivers are sufficiently acid to jeopardize young fish.
>
> Similarly, in Nova Scotia, salmon are extinct in 9 rivers and 11 others in the province are considered threatened.

Destruction from acid precipitation may not be limited to aquatic resources. There is evidence to suggest that North American forests may also be a great risk as acid deposition increases. A 45 percent decrease in the density of red spruce in Vermont has been observed, as the surrounding soil grows increasingly acidic.

Scientists from the research center of a Canadian paper company recently published a paper summarizing German studies suggesting serious die-back of spruce and beech forests in areas receiving heavy acid deposition.

These environmental trends have potentially alarming consequences for our national economy as well as that of the Canadian provinces. We in the Northeast depend on a healthy environment for our livelihood. Our land and water are a critical component of our forestry, fishing, agriculture and tourism industries. We have long recognized the irreplaceable nature of these resources and have treated them as valuable, not disposable, commodities.

Our efforts are not enough. Pollution from hundreds of miles away now threatens our air, land, and water resources, and we are powerless to prevent it.

Consider the nature of this threat:

> Acid precipitation has been estimated to cost $250 million annually in damages to lakes and streams east of the Mississippi;
>
> The economic effect of acid precipitation on existing economic activities in the eastern United States was estimated at $5 billion in 1978;
>
> Approximately $1.5 million in angling revenue is lost each year in just the Adirondacks.

Add to these figures the devastating loss to Maine's economy if forest productivity is retarded by acid rain—in a State 90 percent forested, where 30 percent of all manufacturing jobs are in the pulp and paper or wood and lumber resources industry. Those industries combined produce better that $2½ billion worth of products, which is 43 percent of the value of all products produced in Maine.

The Canadian provinces are faced with economic impacts of equal dimension from acid rain damage to their natural resources.

These are the facts, The United States and Canada, who share a common stewardship of one of the richest land masses in the world, are faced with a potential environmental disaster with frightening economic ramifications.

Yet the American and Canadian responses to this situation have been diametrically opposite.

The Canadian Government, on the one hand, considers the acid rain issue its most pressing domestic and international problem which must be addressed by commitments to reductions of sulfur emissions in both countries now.

The current American administration, on the other hand, takes the position that not enough is known about the problem and that more study is necessary before any corrective action is required in this country.

The position taken by the President and the Environmental Protection Agency has serious international implications. The large quantities of acid rain generated in the United States and exported to Canada are severely straining U.S.-Canadian relations. We are neighbors and friends. Our relationship spans more than a century, and is a mutually beneficial one.

But unless the United States reduces its large contribution to Canadian acid rain levels, the historic relationship between our two countries will be sorely tested, by a problem which the people of my State, and the rest of the Northest, are not responsible.

Prime Minister Trudeau has made Canada's concerns known to President Reagan. The President responded that he is committed to solving the problem.

The United States is also bound by the Memorandum of Intent entered into with Canada in August of 1980. We are committed to combat transboundary air pollution by the development and legislative enactment of domestic air pollution control strategies and by vigorous enforcement of existing laws.

There is no evidence to date that the United States is living up to those commitments, I have stated my resolve to fulfill them, in the form of a bill introduced last fall, S. 1706. The Administration's opposition to my legislation is in direct contradiction to the President's commitment to Prime Minister Trudeau and to the Memorandum of Intent.

It is thus incumbent upon the legislative branch to fufill the American commitment to action.

My bill will accomplish this through two complementary policies.

The first deals with the short run. The bill prohibits any increase in existing sulfur dioxide and nitrogen oxide emissions. Emissions would not be permitted to increase over the levels that existed on January 1, 1981.

This is a reasonable approach. In the face of growing evidence of natural resource damage from acid deposition, certainly it is the better course of wisdom not to make the problem worse. Emissions have in fact been on the increase in 1981. During the first 6 months of that year, the Environmental Protection Agency approved relaxations for 23 sources, most of them in the Midwest, resulting in the emission of an additional 50,000 tons of sulfur dioxide annually. Another eleven applications for relaxations totalling 30,000 tons of sulfur were still pending at that time.

These increases run counter to the Memoradum of Intent, which states that both governments shall "promote vigorous enforcement of existing laws and regulations as they require limitation of emissions from new, substantially modified and existing facilities in a way which is responsible to the problems of transboundary air pollution."

The second goal of S. 1706 is an actual reduction in regional sulfur dioxide emissions over the longer run.

This policy is grounded upon the judgment that we know enough now to act.

The most prestigious independent scientific body in this country, the National Academy of Sciences, stated in a report last fall:

"Although claims have been made that direct evidence linking power-plant emissions to the production of acid rain is inconclusive, we find the circumstantial evidence for their role overwhelming. Many thousands of lakes have already been affected, according to estimates by European and North American scientists. Acidified lakes have been found in areas where geological factors, such as volcanism and the weathering of pyrites, or biological factors, such as acid bog drainage, cannot be implicated. At current rates of emission of sulfur and nitrogen oxides, the number of affected lakes can be expected to more than double by 1990, and to include larger and deeper lakes. There is little probability that some factor other than emissions of sulfur and nitrogen oxides is responsible for acid rain."

Their report concludes further that:

"The Committee believes that continued emissions of sulfur and nitrogen oxides at current or accelerated rates, in the fact of clear evidence of serious hazard to human health and to the biosphere, will be extremely risky from a long-term economic standpoint as well as from the standpoint of biosphere protection.

"Of the options presently available only the control of emissions of sulfur and nitrogen oxides can significantly reduce the rate of deterioration of sensitive freshwater ecosystems . . . In the most seriously affected area . . . This would mean a reduction of 50 percent in deposited hydrogen ions. Control of SO_2 from new electrical generating plants alone would be insufficient to accomplish this, and thus restrictions on older plants must be considered."

My bill implements these recommendations.

I agree that we should continue to gather as much scientific information on acid rain as possible. But it is my judgment that study alone is not an adequate response.

Specifically, my bill provides a 10 million ton reduction of sulfur dioxide emissions in the 31-State region east of or bordering the Mississippi River over a 10-year period. This is approximately 40 percent of total sulfur emissions in the region now, from all stationary sources.

This magnitude of reduction is necessary to protect our resources and avoid the costs incurred from their damage or loss. The extent of the resources at risk—both their inherent value and their economic worth—is incalculable. Once lost, our lakes, our forests, our soils, cannot be replaced. And some of those resources have already been lost.

By cutting sulfur loadings significantly, we can buy some additional time to perfect our knowledge. It has been suggested that we should not act at all because our understanding of the acid rain phenomenon is incomplete.

I take a different view—that for a reasonable investment, we can protect the resources whose buffering capacity has been reduced but not exhausted. I believe it is our responsibility to make such an investment while we still can.

The contribution of each of the 31-States to the total sulfur emissions in the region is unequal. My bill reflects that, and seeks to apportion cleanup responsibility accordingly. Each State will be required to contribute to the 10 million ton reduction. But each State's share of the reduction will be in proportion to its contribution to the total sulfur emissions in the region.

It will be said that my bill costs too much, I emphasize that my bill does not impose a new cost; It simply reallocates an existing cost now being exacted in Canada, in Maine and the rest of New England in the form of irreparable damage to our natural resources. Industries in the Midwest would be required to pay for cleaning up the sulfur emissions they now export freely to the Northeast. They would be required to bear the burden of their activities instead of simply reaping the benefits of those activities.

In closing, I emphasize the high risk of the Administration's acid rain policy, from an environmental and economic perspective, and with respect to our relations with Canada.

Every action of this Administration indicates an unwillingness to take any action to reduce sulfur emissions. The Canadian government, however, has made a good faith effort to live up to its commitments in the Memorandum of Intent. Their actions should be an incentive for similar good faith efforts by the United States, but this will not occur unless the Congress acts.

Canada has already required the International Nickle Company to reduce substantially by 1983 sulfur emissions at its Sudbury smelter. Ontario Hydro, the publicly owned provincial utility, has been ordered by the provincial government to reduce its sulfur and nitrogen oxide emissions by over 40 percent by 1990.

From the perspective of the Canadians, it has become quite obvious that the current American Administration intends to do everything in its power to weaken the existing Clean Air Act, to weaken its implementing regulations, and to ignore even the international implications of such a course of action.

It is little wonder that acid rain has become a major bilateral issue. The official Administration position is an affront to one of our most important allies.

In my regular contacts with officials of the Canadian government, I continue to assure them that I and many of my colleagues in the legislative branch share their commitment to action.

I urge all of the Members of this Committee to join with me to implement our existing commitment to Canada through the enactment of my legislation.

Senator PRESSLER. Thank you, Senator Mitchell, for your fine statement.

Let me ask you the same question I addressed to Senator Moynihan. As a part of any treaty with Canada, would you want all surplus unscrubbed coal-fired generation that is not necessary for system reliability stopped, and would you want necessary facilities to be replaced over time with cleaner facilities as a condition in any treaty?

Senator MITCHELL. Mr. Chairman, I have set out what I think the United States should do in my legislation. My legislation does not direct any specific course of action by those responsible for sulfur emissions. Rather, my legislation establishes reduction levels which must be met and then leaves it up to the States, and the industries, and the utilities themselves to determine where those reductions should occur and what is the most feasible manner for them to occur.

So, I have no comment on what should or should not be included in a treaty with the Canadians. My own view is that the preferential method is not to direct specific methods by which reductions can occur, but rather merely to mandate reduction levels and leave it to the ingenuity of industry and the utilities—subject to State supervision in their respective States—as to how to come up with the best method of doing that.

Indeed, my bill sets forth three or four different alternatives which may be considered.

Senator PRESSLER. With regard to Canada, I understand the Canadian Government licensed and now allows Ontario Hydro to export the entire power output from a surplus unscrubbed coal-fired facility. Also, it is my understanding that Ontario continues to accelerate construction of nuclear units even though they already have at least a 20-percent surplus capacity, some of which they are exporting.

Also, would you want to restrict the U.S. and Canadian nuclear power generation because of international uncertainties about the disposal of nuclear waste? That is two questions.

Senator **Mitchell**. Let me deal with the first part of it. As I stated in my prepared statement, the information provided to me is that Ontario Hydro has been ordered by the Provincial government to reduce both its sulfur and nitrogen oxide emissions by 43 percent by 1990. So, it appears that there is a good-faith effort being made there.

With respect to the problem of nuclear power and radioactive waste, that is, of course, a separate issue unrelated to the subject of this hearing.

I will be very glad to discuss that briefly because I serve on the Nuclear Power Subcommittee which has just recently drafted legislation that will be going to the full Senate in the near future.

I think it is imperative that the United States adopt a national policy for the disposal of radioactive wastes which have accumulated in the 37 years since we entered the atomic age in this country. I think it has been nothing short of a national scandal that we have, as a Nation, permitted these large quantities of waste to develop without any rational policy for their disposal.

It is my hope that the legislation that the committee on the Environment and Public Works will be shortly sending will be adopted as a first step in the development of such a policy.

Essentially, what it does is prescribe a method for the selection and development of a permanent repository for all radioactive waste.

Senator **Pressler**. A subject that is dear to my heart is soil and water conservation. Do you feel there is sufficient knowledge linking soil and watershed problems with the air chemistry of certain chemicals emitted hundreds of miles away? Can you identify for the committee the research findings supporting a firm link?

Senator **Mitchell**. This is one of the arguments most frequently raised, Mr. Chairman. You are going to hear from the Administrator for Air for this administration later today, and I have heard her testify several times. The testimony is,

> Well, we do not know enough about the problem, there are not enough scientific basis. We have to study it more, 5 more years of study; 10 more years of study, maybe then we will know something.

I just want to say that the most prestigious, most respected independent scientific body in this country, if not the world, is the National Academy of Sciences, and I can do no better, Mr. Chairman, than to quote portions of a report which they submitted just a few months ago. I quote now the National Academy of Sciences:

> Although claims have been made that direct evidence linking powerplant emissions to the production of acid rain is inconclusive, we find the circumstantial evidence for their role overwhelming.
>
> Many thousands of lakes have already been affected according to estimates by European and North American scientists. Acidified lakes have been found in areas where geological factors such as volcanism and the weathering of pyrites, or biological factors such as acid bog drainage, cannot be implicated. At current rates of emission of sulfur and nitrogen oxides, the number of affected lakes can be expected to more than double by 1990, and to include larger and deeper lakes. There is little probability that some factor other than emissions of sulfur and nitrogen oxides is responsible for acid rain.

Their report concludes with this statement.

> The committee believes that continued emissions of sulfur and nitrogen oxides at current or accelerated rates, in the face of clear evidence of serious hazard to human health and to the biosphere, will be extremely risky from a long-term economic standpoint as well as from the standpoint of biosphere protection.

Of the options presently available only the control of emissions of sulfur and nitrogen oxide can significantly reduce the rate of deterioration of sensitive freshwater ecosystems. In the most seriously affected area this would mean a reduction of 50 percent in deposited hydrogen ions. Control of SO_2 from new electrical generating plants alone would be insufficient to accomplish this and thus restrictions on older plants must be considered.

Now, I say to those who say there is no scientific basis—and I wish you would ask the Administrator when she comes here today—if they do not accept the scientific basis of the National Academy of Sciences, what scientific evidence will they accept 5 years from now, or 10 years from now, or 15 years from now?

The answer is clear; none, because the statements being made that there is no evidence to support action now are an excuse for inaction, and that excuse will not diminish because the experience of the next 5 or 10 years is going to be the same as the past 5 years, there is going to be conflicting evidence. We are not going to have every study reach the same conclusion.

But that exists throughout human affairs. The evidence now in support of action is far greater than the evidence that existed in 1970 when Congress adopted the Clean Air Act, and the same excuses were made then that are being made now by many of the same people: "We do not know enough to act, we have to study it."

Yet, is there a person in this country who now will stand up and say in public we should repeal the Clean Air Act, that it has not provided a net benefit in our society? Every major environmental control legislation ever proposed has been met with the same argument, "We do not know enough, we have to study it more."

I say, Mr. Chairman, as the National Academy of Sciences said, the evidence is overwhelming; we must act now. I believe we should act now and I commend you for having this hearing to highlight the importance of the problem.

Senator **Pressler**. Thank you very much, Senator Mitchell. I thank you for your testimony and for taking your time this morning. I look forward to hearing more from you.

Senator **Mitchell**. Thank you, Mr. Chairman.

Senator **Pressler**. Now I shall call on the panel addressing conservation, environmental, and legal issues.

The panel is Mr. Ken Kamlet, director, Pollution and Toxic Substances Division, National Wildlife Federation. Mr. Wynn Eakins from the great State of South Dakota, president of the Izaak Walton League. Mr. Robert E. Stein, president of the Environmental Mediation International, Washington, D.C.

We will go right to left since on the right is Wynn Eakins of Clear Lake, S. Dak. Wynn, we have not had a chance to say "hello" properly. Perhaps each of you could introduce yourselves briefly. If you could summarize your statements in about 8 to 10 minutes, I will put the entire text in the record and have time to ask you some questions.

STATEMENT OF WYNN EAKINS, PRESIDENT, SOUTH DAKOTA DIVISION, IZAAK WALTON LEAGUE OF AMERICA, CLEAR LAKE, S. DAK.

Mr. **Eakins**. Mr. Chairman, I have a prepared statement for the record and I will summarize it to a great extent.

Following Senator Mitchell I am not too sure that I have anything to add in that general context.

I am Wynn Eakins of Clear Lake, S. Dak., and I appear before you gentlemen as a concerned citizen of the United States. My Education includes B.S. and M.S. degrees in wildlife conservation and wildlife management, and I served as research director in the biological laboratories at Fort Detrick and as research administrator in the Cambridge Research Labs in Massachusetts. I have a little background in this matter.

At present I am a regional governor in the Izaak Walton League and I am concerned with the States of Idaho, Montana, North and South Dakota, and Nebraska.

We do have some acid rain trouble beginning to show up in these Western States and this is beginning to be a concern in that area.

I joined the Izaak Walton League in 1948 and I am glad to still be a member of this 60-year-old organization.

As far as the matter covered by Senator Mitchell, my statement goes down through and covers him almost point by point. There is no point in being redundant. He did not mention the Louis Harris Survey as regards the American people and the Clean Air Act, and regulations in that regard.

Louis Harris before a House Committee on Environment submitted a current survey back in October, "By 80 to 17 percent a sizable majority of the public does not want to see any relaxation in existing Federal regulation on air pollution."

He found that, "Not a single major segment of the public wants the environmental laws made less strict." By 58 to 38 percent he found the majority opposes relaxing current antipollution standards.

Mr. Harris further said, "This message on the deep desire on the part of the American people to battle pollution is one of the most overwhelming and clearest we have ever recorded in our 25 years of surveying the public."

That in itself shows the minds of the American public, Mr. Chairman and regards their attitudes on restrictions or constraints as regards the environment.

We all know about the pH level and losing lakes. What we do not cover often enough is the fish. We lose the fish, and I am very concerned with them.

But the lakes are going because they are getting acid leaching from out of the forest floors. We do not know how much these forest floors are going to stand before we start to lose our timber. Sweden has lost their timber. Germany has terrible destruction of their timber, terrible stresses on it.

If any of us have ever visited around Sudbury that Senator Moynihan spoke of earlier, it is devastation that you cannot imagine. For miles it is just bare rock where it used to be forest and streams—just bare rock for miles, all from the nickel-mining smelter there. This is an insidious instrument that we have out there destroying our total environment, it is getting there.

Now, we have tall stacks built since 1970 by industry. As they say, they built the stacks to get pollution away locally. Of course, what happens, they put it way up into the atmosphere and it is coming down somewhere else. It is kind of like in a battle when all of a sudden your own guns begin to kill your own soldiers. You call up headquarters and they cease firing. Our industry friends should "cease firing."

The people in New England are getting an awful lot of friendly fire from their own citizens from the Ohio River Valley, Illinois, and Indiana. This acid rain is really a "friendly fire."

Now, we are all U.S. citizens and it seems to me that with all this material available, particularly as nicely covered as Senator Mitchell did, it is time for the people involved with this friendly fire to call a halt to it and get on with the business that they do know they have to do. As American citizens I would think they would get out and do it.

The Izaak Walton League fully supports the position of Senator Mitchell and S. 1706, and we support any action in the total acid rain control field.

Thank you, Senator.

[Mr. Eakins' prepared statement follows:]

Prepared Statement of Wynn Eakins

Mr. Chairman: I am Wynn Eakins of Clear Lake, South Dakota. I appear before you Gentlemen as a concerned citizen of these United States. My education includes BS and MS degrees in Wildlife Conservation and Economic Zoology, respectively. I served as a Research Director at the Biological Laboratories, Ft. Detrick, Maryland, and as Research Adiministrator at the Cambridge Research Laboratories, Lexington, Massachusetts.

Today I also represent the Izaak Walton League of America (IWLA). The League is a national, citizen-based conservation organization of over 50,000 members, dedicated to furthering the conservation and wise use of this nation's natural resources, its soil, water, wildlife and air. The League is one of the oldest (60 years) and most respected organizations in the conservation field. I formed a chapter and joined the League in 1948. Today I serve as a Regional Governor of the IWLA for Idaho, Montana, North Dakota, South Dakota, and Nebraska, and currently serve as Division President for South Dakota.

The League welcomes this opportunity to encourage acid rain control and to express complete support of S. 1706, the Acid Deposition Control Act, introduced by Senator Mitchell.

Gentlemen, in addressing the acid rain situation we first realize that, to date, this problem has been responsible for a tremendous number of studies, reports, surveys, etc., prepared by very learned individuals of government, industry, conservation interests, and the academic field. Our prestigious and independent National Academy of Sciences recently released a definitive report in which they found the circumstantial evidence for power plant emissions causing acid rain to be "overwhelming." The National Commission on Air Quality stated last March that: "Congress should require a significant reduction by 1990 in the current level of sulfur dioxide emissions in the eastern United States."

Louis Harris, the nationally known pollster, in testimony before the House Subcommittee on Health and the Environment, noted that in a recent poll:

". . . by 80 to 17 percent, a sizable majority of the public does not want to see any relaxation in existing federal regulation of air pollution."

". . . not a single major segment of the public wants the environmental laws made less strict."

". . . By 58–38 percent, a majority opposed to relaxing current auto pollution standards." Mr. Harris felt that,

". . . this message on the deep desire on the part of the American people to battle pollution is one of the most overwhelming and clearest we have ever recorded in our 25 years of surveying public opinion."

You and I know that a pH of 7 is neutral, that a pH of 5.6 is that of normal rainfall, and that rain below pH 5.6 is increasingly more acidic. We know that fish and aquatic life die rapidly at pH 5.0 and below. We know that a pH of 4.6 is about the average for rainfall today in the eastern states, and that soil and water buffering prevents total chaos. We know from our newspapers that individual storms are recorded at a pH of 3.4 and lower. This is over 150 times the pH of normal rain. We also know that in Eastern North America, over 90 percent of the sulfur emissions are man-made.

You and I have read of 5,000 lifeless lakes in Sweden; of hundreds of lifeless lakes in Ontario with 48,000 more very susceptible; of the death of lakes in New York, Minnesota, Wisconsin, and Michigan; we have been apprised of the impending loss of fishing to about 13.9 million anglers with resulting economic loss in major recreation industries such as boats, tackle, motors, etc.

We all have read about the total devastation of the natural landscape surrounding the big smelter at Sudbury, Ontario. My visits there impressed on me the ruthlessness of acid gas emissions.

We have read how the utility and smelting industry moved to building tall stacks, at least 170 of them over 500 feet high in the United States. These relieved local pollution, but increased the acid rain downwind. As early as 1974 the American Electric Power advertised its pioneering role in building tall stacks, proclaiming that they dispersed "gaseous emissions widely in the atmosphere so that ground level concentrations would not be harmful to human health or property." Thus several years ago industry was aware of and concerned with the damages of sulfur and nitrogen emissions.

From several reports we have conclusive evidence that acid rain has damaged forests in Sweden and Germany. We know that the Canadian forest products industry company of Domtar, Inc. is very concerned about its future due to acid rain. Acid rain effects on U.S. forests are not so well documented but as the buffering capacity of the forest floors decreases, forest damage may become alarmingly apparent.

Human implications? Ontario's Minister reported that in a Swedish hospital using acidified water the levels of mercury, cadmium, copper and lead reached toxic levels and in at least three documented cases, kidney patients died from high aluminum content in their bodies from water used in the hospital's dialysis machines.

We know that our state and national lung associations vigorously support pollution control, and that the American Medical Association has formally expressed its strong suspicion that acid precipitation damages health.

We have also learned of the very extensive damage caused by acid rain to limestone and marble buildings, statues and other structures.

There are some things we have not read or heard—exactly how the emissions of sulfates and nitrates mix with water in the atmosphere to become acid water. However, this is knowledge we do not require prior to taking positive corrective action.

There have been many cost estimates made for reducing harmful emissions and there will be many more—but Gentlemen, no action means billions upon billions of dollars in economic loss from our forests, lakes, fisheries habitat, wildlife habitat, buildings, crips (yes, there is evidence of real loss showing up) and tourism. For example, a study done for the EPA in 1980 by Thomas Crocker of the University of Laramie, Wyoming, estimates that the annual benefits of controlling acid rain exceed $5 billion east of the Mississippi.

Also, our good neighbor to the north, Canada, has a real stake in your actions here. Negotiations are now going ahead toward a U.S.-Canada Air Quality Agreement. But, Gentlemen, such an Agreement won't be worth the paper it's printed on if the Clean Air Act does not contain specific provisions to control sulfur and nitrogen oxide emissions. How can we fulfill our international responsibilities to Canada if we don't have effective and enforceable laws on our books?

We concur wholeheartedly with Senator Mitchell in remarks to his colleagues when introducing S. 1706:

"While I do not consider the cost of acid precipitation strategy insignificant, neither do I consider the cost of damages to our natural resources insignificant. We must not forget that these costs are as real, if not as easily documented yet, as control costs. This policy is grounded on the judgment that we know enough to act now—by cutting sulfur loadings significantly, we can buy some additional time to perfect our knowledge which is admittedly imperfect. I urge my colleagues to keep in mind that damage, in environmental and economic terms, has already occurred. If the sources of acid rain are merely studied for another five or ten years, the natural resources of many states, as well as their economies, may be irrevocably damaged."

May I point out that when President Eisenhower asked for a multi-billion dollar budget for an interstate highway system the concept was staggering, yet a handful of Senators and Representatives made it a reality—we of the IWLA urge you Gentlemen to make S. 1706 a reality!

In closing here, I will paraphrase a part of President Lincoln's Gettysburg address: "The world will little note nor long remember what we say here—but—Gentlemen, the effects of what you hear and do here on this matter of acid rain will affect generations to come."

Thank you.

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FACT SHEET ON ACID RAIN

Acid rain has become a matter of increasing interest and debate. Numerous studies have demonstrated that acid rain is adversely affecting many lakes and rivers in the United States and Canada. There are growing indications that acid rain may be having an impact upon crops and forests as well.

A number of strategies for controlling acid rain have been proposed. The cost and desirability of acid rain control is now being debated in the United States and Canada. In the course of this debate, a number of questions about the causes, effects and controllability of acid rain have been raised.

This fact sheet seeks to provide answers to these questions.

Question 1. What causes acid rain?

Answer. Acid precipitation is rain or snow that contains significant amounts of sulfuric acid or nitric acid. Sulfuric or nitric acid is formed when sulfur dioxide (SO_2) or nitrogen oxide (NO_x) gases emitted by industrial or transportation sources undergo a chemical transformation in the atmosphere.

The U.S. National Commission on Air Quality, in its March 1981 report, found that the process by which manmade pollutants are transformed into acid rain is now "reasonably well known." The SO_2 or NO_x gas released into the atmosphere is first oxidized to sulfate or nitrate particles. If water vapor is present, the particles are further transformed into sulfuric or nitric acid, which contaminates rain, snow, or fog. Otherwise, the sulfate or nitrate particulates can be deposited on the ground in dry form, and later combine with surface groundwater to produce sulfuric or nitric acid.

The SO_2 or NO_x emissions can remain aloft for several days. The longer the time aloft, the greater the quantity of SO_2 or NO_x transformed into particulates or acid. While in the atmosphere, SO_2 and NO_x and their transformation products can be transported hundreds or even thousands of miles by weather systems.

Man-made pollution is responsible for most of the sulfur dioxide and nitrogen oxides. Although small quantities of SO_2 are naturally present in the atmosphere, in eastern North America over 90 percent of the sulfur emissions are man-made. According to EPA figures, 65 percent of the man-made SO_2 comes from electric utilities; the remainder is produced by various industrial processes and transportation. Automobiles are the main source of nitrogen oxides (about half), with electric utilities contributing another 30 percent of NO_x emissions.

There is little doubt about the strong link between man-made emissions and acid rain. According to the NAS, the circumstantial evidence "linking power-plant emissions to the production of acid rain (is) . . . overwhelming."

Question 2. What effects of acid rain have been observed?

Answer. Abnormally high levels of rainfall acidity have been observed in many areas of the United States, and in eastern Canada. (Normal rainfall is naturally somewhat acidic, due to the acid that results from the combination of carbon dioxide and water vapor. While the acidity of natural precipitation varies somewhat, it is normally between pH 5 and pH 5.6. When rain is abnormally acidic, it also contains high quantities of sulfate and nitrate, products of the transformation of sulfur and nitrogen pollutants. This is the kind of high acidity that has been found downwind from industrialized regions.)

Rain that is 10 to 40 times as acidic as normal rainfall has been occurring frequently in many parts of New England and New York. The average pH scale of rainfall over substantial portions of the Northeast is 4.3, approximately 10 times normal levels. Comparable levels of acidity are occurring in many parts of Canada. Highly acidic rainfall has also been observed in a number of southeastern states, particularly Florida, Virginia, Texas and North Carolina, in the northern plains states of Minnesota and Wisconsin, and in the Colorado Rockies.

According to estimates by scientists in North America and Europe, many thousands of lakes in North America and Europe have already been affected by acid rain. There has been extensive damage to aquatic life. In the Adirondack Mountains, the New York State Department of Environmental Conservation has found that fish populations are endangered in more than half of all the lakes and ponds in the region, and more than 200 of the lakes have become totally fishless. (When the pH of a lake falls much below 5, most fish cannot survive.) In Ontario, 48 percent of 2,600 lakessa mpled to date have been identified as very sensitive to acid rain. In Sweden and Norway, fish life has been destroyed in more than 6,500 lakes. The danger to fish populations is particularly acute during the spring, when melting snow causes rapid decreases in pH values, a condition known as "spring shock."

The National Academy of Sciences concluded in its report issued September 1981 that acid rain is causing "widespread damage" to our aquatic systems, including "higher concentrations of toxic metals." Already, according to the Academy, "several important species of fish and invertebrates have been eliminated" in acidified lakes and streams.

Question 3. Where is most of the acid rain coming from? Is acid rain principally of local or long-range origin?

Answer. Although some limited acidification is due to local sources, data compiled by the National Commission on Air Quality confirm that acid rain is principally an interstate and international problem. The data show that 70 percent of the sulfur deposited in New York and New Jersey each year is attributable to sources outside the region, mostly from sources in Illinois, Indiana, Ohio, and mid-Atlantic states. On the average, between 75 and 90 percent of sulfate concentrations in any state in the eastern half of the United States originate outside the state.

The data also demonstrate that sources in the Ohio River Valley alone account for 70 percent of the sulfate in central Pennsylvania, and 35 percent of the sulfate in the Adirondack Mountains and northeastern New York state. Four states in the Ohio River Valley—Ohio, Indiana, Illinois, and Kentucky—are responsible for nearly one-fourth of all the SO_2 produced in the United States each year. Sources in Ohio alone emit as much SO_2 as New York and the six New England states combined.

Tall stacks constructed by electric utilities and smelters to disperse emissions have compounded the transboundary pollution problem. Prior to 1970, only two stacks exceeding 500 feet were in existence; today, in the United States there are more than 175 such stacks. These stacks were built during the 1970's in order to reduce ambient air pollutant concentrations in the vicinity of the stacks (and thus to comply with the Clean Air Act's ambient air requirements).

The net effect has been the export of enormous quantities of air pollution to neighboring states and provinces.

Question 4. What regions are most affected by acid rain?

Answer. There is little question that the regions hardest hit to date by acid rain have been New York, the New England states, and the provinces of Ontario, Quebec, and Nova Scotia in Canada. These areas lie generally downwind from major SO_2 emitters in the Ohio Valley and the industrial mid-Atlantic regions of the United States and Canada. Aquatic systems in these receptor areas also have poor buffering capacities—the rocks and soils lack natural alkalinity that might otherwise help to offset the damaging consequences of acid rain.

But the effects are showing up in other areas as well. In the northern plains, particularly Minnesota and Wisconsin, several thousand lakes have been identified as acid-sensitive. In the Southeast, from Florida through Kentucky, rainfall with pH values between 4.6 and 4.2 (5 to 10 times more acidic than pure rainfall) have been observed with increasing frequency. In Raleigh, North Carolina, there have been occasions when the rainfall has been more acidic than vinegar.

In the Western states, the chief culprit is NO_x, primarily from automobile exhausts. NO_x from metropolitan centers along the Pacific Coast is being deposited hundreds of miles to the east in the Sierras and Rockies in the form of nitric acid-contaminated rain or snow. Studies published in *Science* magazine show that precipitation with 4.6 pH (at least five times normal acidity) is occurring frequently in parts of Colorado. Mountain lakes in Colorado and California are becoming acidic, with local residents concerned about potentially adverse consequences for the tourism and recreation industries. Metal smelters also play a role in the West; non-ferrous smelters accounted for more than 2 million tons of SO_2 emissions in 1980.

Question 5. To what extent is Canada responsible for causing acid rain, and what is Canada doing about it? How strict are Canadian clean air laws compared with those in the United States?

Answer. Approximately 90 percent of the SO_2-based acid rain in the northeastern United States is of domestic origin, and 10 percent is of Canadian origin. Of the acid rain affecting Canada, about 50 percent originates in the United States, and 50 percent in Canada. In regions of particular concern in Canada, such as the Muskoka-Haliburton tourist and recreation area in Ontario, as much as 75 percent of acid rain originates in the United States. Overall, according to the National Commission on Air Quality, the United States "exports" about four times as much SO_2 as it "imports" from Canada each year.

Canada thus receives far more acid rain than it exports. But both countries are responsible for generating SO_2 and NO_x emissions that cause acid rain. The problem is a mutual one, requiring cooperative efforts to control it.

The structure of Canadian clean air laws differs from those in this country. Unlike the U.S. Clean Air Act, neither mandatory criteria nor air quality standards are set at the federal level in Canada. The Canadian federal government issues national ambient air quality objectives for the major air contaminants. However, each province establishes emissions levels for sources within its jurisdiction to satisfy provincial ambient air quality criteria. This system has resulted in standards which are generally as strict—and in many cases stricter—than standards under the Clean Air Act. For example, the Canadian ambient air standards for SO_2 (in permissible annual average micrograms per cubic meter) are: Ontario–55; Quebec–55; Alberta–30; Manitoba–60. The comparable levels under the U.S. Clean Air Act are 80 micrograms for the primary standard (health-based), and 60 micrograms for the secondary standard (welfare-based). Thus, for provinces with significant emission levels, Canadian standards for SO_2 are as tough or tougher than either the primary or secondary U.S. standards.

With respect to certain specific sources, Canadian controls are also being tightened. The largest single source of SO_2 on the North American continent is the INCO Ltd. smelter at Sudbury, Ontario. In the mid-1960's, the smelter emitted SO_2 at a rate of about 7,000 tons per day. Under Ontario regulations, this has been cut to a current emissions level of 2,500 tons per day. A further cut—to 1950 tons per day—will take effect in 1983. New sources have even stricter controls; the zinc and copper smelters built by Texas Gulf, Inc., at Timmins, for example, are achieving 97 percent and 95 percent sulfur containment, respectively.

Under a recently promulgated regulation Ontario Hydro, Ontario's major utility, is required to reduce SO_2 and NO_x emissions 43 percent below current levels by 1990. This will put Ontario Hydro below pre-1970 emission levels, despite a projected increase in power generation of about 30 percent by 1990.

The tight standards on stationary sources in Canada represent the first significant effort to control air pollution beyond the traditional locally-based ambient standards. The Canadian approach is specifically designed to deal with problems associated with long-range pollution transport—including acid rain.

In the area of mobile sources, however, Canada's requirements are weaker than the U.S. standard. The U.S. Clean Air Act specifies limits of 1.0 grams per mile of NO_x for 1981 gasoline-powered automobiles. In Canada, the comparable standard for NO_x is 3.1 grams per mile. Canadian officials readily acknowledge the need to tighten the mobile source NO_x standard, and the standard is currently under review.

Question 6. Will acid rain controls make it easier for Canadian utilities to sell electricity to customers in the United States?

Answer. An acid rain control program, which will require significant pollution controls for coal-fired utilities, will unquestionably increase the cost of coal-fired electric power. The 43 percent reduction in SO_2 emissions required by such a program would cause an estimated 2 percent increase in rates by 1990 (see question 12). But these costs should not directly confer a competitive advantage on either side, since they will be imposed equally on both Canadian and U.S. coal-fired utilities.

Canadian utilities have on occasion been requested to supply additional power to several American utilities. In particular, Ontario Hydro has responded to a request by General Public Utilities to assist in overcoming the power deficits caused by the accident at Three Mile Island. Ontario Hydro's application to supply the additional power, which would be coal-fired, is now pending before the Canadian National Energy Board.

The supply of this power is subject to a non-appealable regulation issued by the Ontario cabinet. The regulation requires a 43 percent reduction in Ontario Hydro's SO_2 emissions by 1990—the amount of reduction that would be required by an acid rain control program. Ontario Hydro has assured Canada's National Energy Board that the GPU contract will in no way alter its schedule for complying with the 43 percent overall reduction required by the Ontario cabinet.

Thus, the sale of this power by Ontario Hydro in no way conflicts with an effective acid rain control strategy, and the Canadian utility is already on a compliance schedule to meet the reduction targets for the end of the decade.

Question 7. Hasn't acid rain been around for centuries? Why has it recently become a problem?

Answer. Normal rain and snow are naturally mildly acidic, due mainly to the presence of carbonic acid (combination of CO_2 and water vapor). The pH of natural rain or snow is in the vicinity of 5.6 (pure distilled water, with no acid whatever, would have a pH of 7). The term "acid rain" does not refer to such mild, natural acidity; it is generally used to denote acid levels ten to one hundred times more acidic. It refers to rain which has been contaminated with sulfuric or nitric acid, which is almost entirely of man-made origin.

Ice cores taken from glaciers in Antarctica, which are thousands of years old, show higher levels of acidity. The reason for this is that the natural process of glacier formation tends to concentrate the carbonic acids naturally present in rainfall and snowfall. There is no evidence whatsoever of any sulfur or nitrogen compounds in the glaciers, which are the acids that are responsible for damaging aquatic systems.

Therefore, although most natural precipitation is slightly acid, it is not true that "acid rain" has been around for centuries. There is no evidence, either historical or geological, of previous episodes of such damaging acidity; it is a uniquely modern phenomenon.

Question 8. Is there any evidence that acid rain is increasing? Why are coal-fired utilities blamed for acid rain, if coal use has remained relatively constant in the United States since the 1940's?

Answer. A number of studies prepared for the National Commission on Air Quality conclude that acid rain has been increasing over the eastern half of the United States for the past quarter century.

A Florida study, for example, demonstrated that in that state the concentration of sulfates in precipitation has doubled, and the concentration of nitrates quadrupled, over the past 25 years. Scandinavian studies indicate a strong correlation between concentrations of sulfates and nitrates in precipitation and acidity.

Several of these studies have been challenged by the utility industry. What is important, however, as the National Commission on Air Quality points out, is that precipitation much more acid than normal continues to be observed over large parts of North America, and currently observed levels are causing increasing numbers of lakes to become acidified. In effect, the areas exposed to acid rain have been increasing.

With respect to coal, although total usage has not increased significantly, seasonal use has changed dramatically. Coal consumption is now much greater in the summertime, due to increased use of air conditioning. Summertime heat and humidity hasten the transformation of SO_2 and NO_x emissions into acid rain. Also, as noted earlier, the construction of tall stacks over the past decade has meant much more diffusion of SO_2 and NO_x emissions into the atmosphere. According to the NAS, the height at which gases are injected into the atmosphere "has increased the probability of oxidation to sulfuric acid." In addition, auto exhausts have increased markedly over the past several decades, and these play a catalytic role in speeding up the oxidizing of SO_2 and NO_x into sulfates and nitrates. Thus, even though overall coal consumption has not changed greatly, sulfates and nitrates that result from coal combustion and a variety of other sources have increased significantly.

Question 9. How can acid rain have differing impacts upon lakes situated within a few miles of each other?

Answer. All lakes have different capacities to deal with incoming acid. The buffering capacity of a lake, more than any other factor, determines its ability to neutralize or absorb acidity. Buffering capacity varies with the nature of the underlying rocks, surrounding soils and vegetation. Lakes with low buffering capacity within regions heavily impacted by acid rain can become acidified within a decade. A lake within the same region can withstand acidic precipitation for a much longer period if the buffering capacity is higher.

In addition, a lake's size and depth, and the rate of "flushing capacity," can affect its response to acid loading. Whether a lake is surface-water fed or groundwater fed also is a major determinant in how it responds to acid rain.

Thus, acid rain can induce very different levels of acidity in lakes situated within several miles of each other.

Question 10. Can the effects of acid rain be neutralized by liming the lakes?

Answer. Liming might be a temporary solution if just a few bodies of water were involved. But tens of thousands of lakes are involved and they are spread over vast areas of North America.

In addition, liming does not necessarily undo existing damage. In a number of lakes where liming has been tried, and fish restocked, the fish have died. There is evidence that chemical imbalances other than pH occur which render aquatic systems inhospitable to fish for many years even after the excess acid has been neutralized. As one scientist observed, "If you take an acid lake and lime it, you do not now have a normal lake; you now have a limed, formerly very acid lake, with a very peculiar water chemistry and a very peculiar biota as a result." (Dr. Harold Harvey, University of Toronto.)

Also, as indicated in the following question, acid rain may be having deleterious effects on our terrestrial systems. These cannot possibly be handled with liming.

Question 11. Other than effects on aquatic life, has any other impact of acid rain been demonstrated?

Answer. Recent observations in Europe and the United States indicate that acid rain may be reducing soil fertility and forest growth. A recent German study has shown that acidified water running through the soil tends to pick up increased amounts of aluminum; the aluminum interferes with the absorption rate of water and nutrients by tree roots. Acid waters also tend to remove important nutrients such as calcium and magnesium from the soil. Studies at the University of North Carolina suggest that acid deposition increases the susceptibility of some plants to drought. The National Academy of Sciences report notes that while the effects on soils, forests, and plants have not been proven, "long-term permanent damage to the ecosystem may result" from the leaching out of necessary nutrients.

There is also some indication that acid rain and its precursors could have an indirect impact on human health. This can occur in several ways. In addition to the nutrient minerals, acidification causes leaching of heavy metals such as mercury and cadmium. These metals accumulate in lakes and streams, and in the tissues of fish that are present. In sufficient amounts, these metals may become toxic. The National Commission on Air Quality noted studies, for example, that fish caught in acid waters in the United States, Canada, and Sweden have higher concentrations of mercury than fish taken from waters that are not acidic.

Acidification also can cause leaching of lead and copper from the plumbing that supplies drinking water systems—such an effect was observed recently in Clarion and Indiana Counties in western Pennsylvania. In New York, the Department of Environmental Conservation has found that ground water in seven upstate counties is sufficiently corrosive to leach copper and lead from pipes and soldered joints, causing the water flowing through the pipes to exceed Federal drinking water standards.

Finally, because the sulfate and nitrate particles that make up the dry form of acid deposition are extremely fine, they are capable of causing serious respiratory problems. These are set forth in the "Northeast Damage Report," a paper prepared for a consortium of Northeastern states.

The terrestrial and health-related impacts of acid rain have not been studied as extensively as the impact on aquatic systems. The evidence that exists suggests grounds for concern in these areas.

Question 12. What steps can be taken to reduce acid rain, and what would they cost? Would the benefits be worth the costs?

Answer. According to the National Academy of Sciences, "only the control of emissions of sulfur and nitrogen oxides" can significantly reduce the deterioration caused by acid rain.

To implement the NAS recommendation, legislation has been introduced in the Senate and House to impose a 10 million ton annual reduction in SO_2 by 1990. The reductions would be required in the 31 states in the eastern United States, and would be allocated on a proportional basis among states in the region. NO_x emission reductions could be substituted for SO_2 emission reductions on a 2-for-1 basis. The controls would bring about a 43 percent reduction in emissions in the region by 1990.

Technologies to achieve these reductions are available. These include scrubbers to remove in excess of 90 percent of sulfur from stack gases, coal washing, and swapping low sulfur fuels for high sulfur fuels. (Coal washing by itself could only achieve 25 percent of the needed reductions.) In addition, new technologies such as fluidized bed combustion methods and limestone injection through multi-stage burner (LIMB) are under active development.

The Congressional Office of Technology Assessment put the cost of a 10 million ton SO_2 reduction program at $3.4 billion per year. The National Commission on Air Quality arrived at a lower figure—$2.2 billion a year—to achieve similar levels of reductions. The Commission stated that the emissions reductions can be "achieved at reasonable cost." The cost estimates vary, depending upon the mix between technologies and coal washing/substitution, and whether interstate trading of emissions is permitted.

According to the Commission, these cost estimates would result in an average utility rate increase of 1.8 percent in the eastern United States by 1990. In states which are particularly dependent upon coal-fired energy sources, the costs are somewhat higher. ICF, Incorporated, in an analysis based on work done for the EPA, estimates that by 1990 a 10 million ton SO_2 reduction program would result in rate increases in Indiana of 7.4 percent; in Ohio, 6.6 percent; in Wisconsin, 5.6 percent; and in Illinois, 2.8 percent.

If new LIMB technology came to be employed, costs could decrease sharply—a recent EPA study suggests that LIMB methods may have as much as an 80 percent cost advantage over other technologies.

Benefits of acid rain reductions are somewhat more difficult to estimate. The 1980 Crocker study at the University of Wyoming, prepared at the direction of EPA, puts the value of reducing acid rain in the eastern one-third of the United States at $5 billion a year. This figure includes $2 billion in effects on materials, $1.75 billion in damage to forest ecosystems, $1 billion in direct effects on agriculture, $250 million in effects on aquatic ecosystems, and $100 million in other effects, including damage to water supply systems.

Question 13. How many jobs might be affected if acid rain controls were initiated?

Answer. Coal industry witnesses have testified before the Senate Environment and Public Works Committee that 98,600 direct mining jobs would be lost in the Appalachian and Midwest coal regions if the 10 million ton SO_2 reduction became law.

This estimate is faulty in at least two respects. First, it assumes that the reduction would be achieved entirely by swapping low-sulfur coal for high- and medium-sulfur coal, and calculates the worker loss impact by considering only the impact upon high- and medium-sulfur coal-producing regions. Even if the assumption were valid, the National Commission in Air Quality points out that the decline of 67 million tons of coal production in Northern Appalachia and the Midwest (where most of the high- and medium-sulfur coal is now produced) would be partially offset by an increase of 34 million tons of coal production in the low-sulfur coal regions of Central Appalachia. Thus, the increased demand for low-sulfur coal would probably generate at least half the number of jobs that might be lost in the higher sulfur coal-producing regions.

Second, to the extent that the law requires new technology to be used (e.g., "best available control technology"), or to the extent that utilities choose to use new technology to meet statutory emission levels, coal-mining jobs need not be affected and new manufacturing jobs will actually be created in pollution control industries. Jobs may also be created in research and development, to the extent that the law succeeds in forcing new technologies to be developed.

There should also be taken into account the job loss or dislocation that could result if acid rain is not controlled. Thousands of jobs in Canada, New England, New York, and Colorado are dependent upon the tourist industry. To the extent that tourism suffers if lakes and rivers become fishless, or forest damage occurs, job losses and dislocation could be considerable.

Undoubtedly some job dislocation could result if effective acid rain control legislation is enacted. But the employment impact on the coal industry is likely to be far more modest than industry figures suggest, and this impact may be partially or totally offset by gains in other sectors of the economy.

Question 14. Doesn't the Clean Air Act already provide for reductions in sulfur dioxide emissions?

Answer. The principal mechanism for controlling SO_2 emissions in the Clean Air Act is the New Source Performance Standards (NSPS), program. Under NSPS, the emission standard for "new" sources (plants constructed after the Act's provisions went into effect) is approximately seven times as strict as the standard for existing sources.

The vast majority of the SO_2 emissions are produced by older plants (utilities and industrial sources)—plants that are categorized as "existing" sources by the Clean Air Act. The difference in standards for old vs. new plants gives utilities and industrial sources a strong incentive to keep cheaper-to-operate existing sources on line as long as possible—in many instances well beyond the time when the old plants would otherwise be retired. Thus, the rate of turnover to newer, cleaner plants is very low.

EPA estimates that at the current turnover rate under existing law, SO_2 emissions will remain at the same level—or even increase slightly—between now and the mid-1990's. EPA does not foresee any significant reduction in total emissions before the year 2000 under current law. Moreover, the EPA estimates were made using 30 or 35 years retirement estimates. The emissions increases will be larger if plants are not retired according to this schedule. This makes control of present plants all the more important.

According to the National Academy of Sciences, if current emission rates of SO_2 and NO_x continue, the number of lakes affected by acid rain is expected to "more than double" by 1990. Controlling only new electrical generating plants, says the NAS, is "insufficient" to accomplish any significant reductions of SO_2 or NO_x emissions in the foreseeable future.

Question 15. To what extent are nitrogen oxides responsible for acid rain?

Answer. NO_x is produced both by stationary sources (utilities and industrial processes) and by automobiles. NO_x currently is responsible for approximately one-fourth to one-third of the acid rain—but this proportion is expected to increase over the next two decades. In parts of the West, NO_x is already the major contributor to acid rain. If current trends continue, by 1990 NO_x-caused acid rain could equal or exceed the acid rain caused today by SO_2 and NO_x.

NO_x pollution also is associated with the production of ozone. High levels of ozone cause crop damage, forest damage and a number of respiratory problems. Ozone, like acid rain, is a product of atmospheric chemistry acting on pollutants. It, too, is principally a transboundary pollutant; most of its damage is done outside the state or province where the NO_x originates.

Available technology to control NO_x from stationary sources is less effective than SO_2 removal technology. Technology is available to control automobile NO_x emissions. The 1982 automobile fleet is meeting the current Clean Air Act requirement for NO_x of 1 gram per mile. This requirement—if it stays in the law—would provide for a steady reduction in NO_x emissions over the next 10 years.

However, the automobile industry is asking Congress to relax the NO_x standard to 2 grams per mile. If this occurs, EPA estimates that there would be no decrease in NO_x emissions, and possibly a slight increase, over the next 10 years.

Question 16. How do we know that controlling SO_2 or NO_x emissions will lead to reduced levels of acid rain?

Answer. Most scientists who have reviewed the issue believe that a strong correlation exists between SO_2 and NO_x emissions and acid rain. This is certainly the view of the National Academy of Sciences, which believes that man-made emissions of sulfur and nitrogen compounds "is the only plausible explanation" for acid rain.

It is a law of nature that material is conserved. In this case, the amount of sulfur emitted into the atmosphere must be directly related to the amount that comes down, since the atmosphere, on a global scale, does not store SO_2 and its oxidation products. Thus, the material that is injected into the atmosphere must come down eventually.

On the average, SO_2 has a life expectancy in the atmosphere of less than five days. The Atmospheric Sulfur Budget for Eastern North America, prepared for Environment Canada in 1979, demonstrated that about 70 percent of the total SO_2 emissions in Eastern North America are deposited on the continental land mass before the air moves off to the east over the Atlantic.

On a regional scale it is clear that those areas with the most acidic precipitation and the highest concentration of air pollutants are co-located. The "hot spot" regions where the highest levels of acid precipitation have been observed in North America and Europe are consistently located downwind of major SO_3 and NO_x emissions—in the majority of cases, many hundreds of miles downwind. See the Report of Work Group I of the U.S.-Canadian Work Groups established by the August 1980 Memorandum of Intent, February 1981.

Thus, while a precise relationship between a single SO_2 source and rain or air quality downwind cannot be conclusively established, nor probably will ever be established, significant reductions in emissions in general must lead to significant reductions in deposition of both acidic precipitation and dry materials.

Question 17. Shouldn't we postpone acting on acid rain until the scientific uncertainties are resolved? Isn't more study needed on the causes and effects of acid rain?

Answer. Title VII of the Energy Security Act passed by Congress in 1980 created an Interagency Task Force on Acid Precipitation to conduct a 10-year study on the causes and effects of acid rain. Congress authorized $20 million in fiscal year 1982 for the Task Force.

In authorizing this effort, Congress expected the study primarily to help provide more precise data on the factors that contribute to the production of acid rain. This includes the proportionate contribution of SO_2 and NO_x, the relative importance of wet deposition (acid rain or snow) vs. dry deposition (sulfate or nitrate particles), and the relative contribution of stationary sources (utilities, smelters) and mobile sources (automobiles, trucks, etc.) to acid rain. The study seeks additional data on the specific roles of weather factors (e.g., sunlight and humidity), atmospheric chemistry and other chemical factors (e.g., vanadium, iron, and manganese).

The existence of these uncertainties, however, should not obscure the fact that a great deal of evidence (both concrete and circumstantial) is currently available about the causes and effects of acid rain. This evidence was analyzed by the President's Commission on Air Quality, which issued its report in March 1981 after a 4-year study, and by the National Academy of Sciences, which issued its report in September 1981.

These recent findings about acid rain include the following:

(*a*) The "broad dispersion of acid rain over large parts of the European and North American continents" represents a "major anthropogenic perturbation" of the environment. (NAS report)

(*b*) Acid rain has led to "severe degradation of many aquatic ecosystems" in the United States, Canada, the United Kingdom, and Scandanavia. "Many thousands of lakes" have been affected. (NAS report)

(c) The waters and soils over "extensive areas of North America" are "susceptible to acidification." (Canada-U.S. Work Group 3A)

(d) There has been an increase in both acidity and toxic substances in many lakes and rivers over the past several decades. This has been observed particularly in New England and southeastern Canada. (Air Quality Commission)

(e) The conditions that lead to the formation and long-range transport of acid rain are "reasonably well known." (Air Quality Commission)

(f) SO_2 and NO_x emissions are transformed in the atmosphere to sulfuric and nitric acids, transported great distances, and deposited on vegetation, soils, and surface waters. (United Nations Conference on the Human Environment study)

(g) Between 75 and 90 percent of sulfate contributions in any state in the eastern half of the United States originate outside the state. (Atmospheric and Environment Research, Inc.)

(h) In the United States and Canada, the sources of acid rain are almost entirely man-made. (NAS and Air Quality Commission reports)

(i) The circumstantial evidence relating power plant emissions to acid rain is "overwhelming." (NAS report)

(j) Acid rain has caused the destruction of "many species of fish and their prey." It has also caused toxic trace metals to reach concentrations in surface and ground waters that are "undesirable for human consumption." (NSA)

(k) Fish taken from acid waters show high concentrations of mercury and other heavy metals. (Interagency Task Force)

(l) In general, acid rain is causing "widespread damage" to aquatic ecosystems. (NAS)

(m) Only the control of SO_2 and NO_x emissions can significantly reduce the rate of deterioration of sensitive freshwater ecosystems. (NAS)

(n) Continued emissions of SO_2 or NO_x at "current or accelerated rates" pose clear evidence of "serious hazard to human health." (NAS)

(o) Stone buildings, monuments, and other building materials, are eroded by a number of pollutants, including acid rain. (Canada-U.S. Work Group 3A)

(p) Provisions of the Clean Air Act that seek to control interstate pollution "have proved ineffective." (Air Quality Commission)

(q) A reduction in SO_2 and NO_x emissions should lessen acid deposition, improve visibility, and help eliminate fine particles that are hazardous when inhaled. (Air Quality Commission)

(r) The needed reductions in SO_2 emissions can be achieved "at reasonable cost." (Air Quality Commission)

Unquestionably, more study will be helpful in resolving the uncertainties about relative contributions to acid rain. But what we know now is clearly sufficient to begin to remedy the situation. While there is risk in taking action based on imperfect knowledge, there is much greater risk—environmental, social, and economic—of delay. As the NAS noted, failure to take action on acid rain would be "extremely risky" to the earth's environment.

The responsible course is to do both. We must expand our research efforts, and we must begin now to significantly reduce SO_2 and NO_x emissions into the atmosphere.

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Senator **Pressler**. I thank you for being here.

What are our interests in South Dakota in this matter? What is your view of the soil and water issue—linking soil and watershed problems with air chemistry contributions?

Mr. **Eakins**. Well, in South Dakota particularly right now, as you indicated earlier, Mr. Chairman, we have the big fire-ups coming into Montana and Wyoming. I believe we had a big one come on line during the last year, a big generator plant. All of those things can begin to affect us.

Minnesota is beginning to have the effects and so is Wisconsin. Their lakes are very susceptible right now, they are showing indication of increased acidity. Where I live, I am only 11 miles from Minnesota. Where does this stuff drop out as the wind changes? We do not know. So, South Dakota is very susceptible to some of these problems.

There have been studies in the soybean field where they estimate acid rain accounted for about 1 percent of lower yields. We are building sunflour milling plants in South Dakota. Maybe we will not need them if we are going to lose our crops.

This is not a "doom or die," this whole thing can be solved. All we have to do is call off this friendly fire, all act like citizens of the United States and get on with it.

Senator **Pressler**. I think you are right, it is a problem we should be addressing at this stage.

It is especially good to have you here because you are from a State that does not have an immediate axe to grind but down the road we may have problems, particularly with our soil and lakes. People forget how many lakes we have, do they not?

Mr. **Eakins**. They talk about Minnesota's 10,000; maybe we have 3,000. But yes, it is a total concern. We are not just talking about fish in some pond in New York, we have a national concern.

It is showing up everywhere, as Senator Moynihan said. It is down in Florida and Georgia now. North Carolina has it showing up. I was out in the High Sierras about 2 weeks ago and they are having trouble up there. It is everywhere and it is manmade. Over 90 percent of all sulfur dioxide in the air is manmade. So, we can control it.

Senator **Pressler**. Thank you. I will next call on Ken Kamlet, who is director of the pollution and toxic substance division, National Wildlife Federation. Is that the one Gaylord Nelson has gone over to, or is that your rival group?

Mr. **Kamlet**. That's the Wilderness Society.

Senator **Pressler**. Have I misspoken?

Mr. **Kamlet**. Well, a little bit. But it is not a rival group, we work together.

STATEMENT OF KENNETH S. KAMLET, DIRECTOR, POLLUTION AND TOXIC SUBSTANCES DIVISION, NATIONAL WILDLIFE FEDERATION, WASHINGTON, D.C.

Mr. **Kamlet**. Thank you very much, Mr. Chairman.

I would only like to add by way of background, I am here on behalf of the National Wildlife Federation, as you said, and its 4.6 million members and supporters around the country, in addition to our 53

State and territorial affiliates throughout the United States. So, we represent a rather sizable constituency who are vitally interested in the significant acid rain problem.

The main point, Mr. Chairman, that I would like to emphasize this morning is that it is critically important that we bring the acid rain problem under control—not as an act of charity to our Canadian friends, as important as our relationships are with Canada—but rather as a matter of vital U.S. self-interest.

Much controversy surrounds the acid rain issue. However, while there are admittedly still uncertainties in the scientific understanding of acid rain, its principal causes and some of its more significant undesirable effects are well known. Most knowledgeable scientists agree that the only effective way to abate acid rain is to control the responsible emissions at their source.

The pollution sources responsible for acid rain are by no means confined to the U.S. side of the United States-Canadian border. But U.S. sources of sulfur dioxide, the principal precursor of acid rain in eastern North America, outstrip Canadian sources by more than 5 to 1, reflecting the greater urgency of control measures on the U.S. side; although certainly the Canadians need to do their share and, as we have heard, they have been.

Although normal rainfall is mildly acidic, large areas of eastern North America experience rainfalls which average 25 to 30 times more acid. The zone of maximum acidity stretches in a corridor through Ohio and Pennsylvania into southern Ontario.

The prestigious National Academy of Sciences has concluded that increased emissions of sulfur and nitrogen oxides from man-made sources are the only possible explanation for acid deposition.

As Senator Mitchell noted, the evidence for the role of coal-fired powerplants in the production of acid rain is overwhelming.

Increased SO_2 emissions since 1955 correlate well with increases in the areas that are subject to acid deposition. Once confined to the Northeast, abnormally acid rains have spread South and West.

A recent National Wildlife Federation evaluation of the acid rain vulnerabilities of the 27 Eastern States, which is summarized in exhibit 8 appended to our testimony, indicated that 15 of the Eastern States must be regarded as extremely vulnerable, with another 10 States being moderately vulnerable to the effects of acid rain.

West of the Mississippi, evidence is mounting of acidified rain and its impacts in at least 11 States, listed on pages 20 and 21. As Mr. Eakins indicated, Wisconsin and Minnesota, very close to South Dakota, are among those that are impacted in those ways.

The best documented impacts of acid rain are on lakes and streams. The data show that in the Eastern United States 31 to 81 percent of the lakes and streams sampled fall in the categories of moderately or extremely sensitive to acid rain, or already acidified.

Thirteen to 48 percent of midwestern lakes fall in the same categories. Half the lakes in the boundary waters canoe area wilderness in Minnesota; 2,600 lakes in Wisconsin, and 10,000 lakes in Michigan are susceptible to acidification. More than 100 lakes and streams from Maine to Minnesota have been shown to be acidified, as were 9 of 11 lakes sampled in northern Florida.

Thousands of lakes in the Adirondacks and Maine, and dozens of streams in western North Carolina have shown increased acidity or deceased alkalinity as compared with earlier observations.

According to one estimate, upwards of 100,000 miles of streams and 20,000 lakes in the United States may be profoundly affected by acid deposition.

The National Academy of Sciences in its September report concluded, as Senator Mitchell noted, that at current rates of SO_2 emission the number of North American lakes affected by acid rain could be expected to more than double by 1990.

The effects of acid deposition on forest and agricultural crop productivity, while less well documented than acid rain's aquatic impacts, are nevertheless cause for great concern. There is substantial evidence to suggest that acid loading will sooner or later lead to a reduction in forest and crop productivity that would be very costly in socioeconomic terms and not feasible to remedy.

There is growing evidence to suggest that acid rain may pose an indirect threat to human health by promoting the migration of toxic heavy metals like mercury into edible fish and shellfish, and by liberating toxic metals from groundwater and plumbing systems used for drinking water supply.

Acid rain precursors may also contribute to impaired visibility, a particularly significant problem in the Western United States. And acid deposition has been linked to damage to bulidings and structures.

Although the proponents of more research and no action on acid rain argue that we have the luxury of sufficient time to delay acid rain controls for 5 years or more until additional research results are in hand, the fact is a number of the most drastic negative impacts of unchecked acid precipitation are cumulative and irreversible. Every year we delay means additional damage to the environment and economy of Eastern North America.

Irreversible impacts include depletion of the buffering capacity of lakes and watersheds as acid-neutralizing materials are used up; depletion of soil nutrients and ions critical to maintenance of soil fertility; and loss of unique ecosystem components.

Although the economic costs of many of the insidious impacts of acid rain defy ready quantification, those effects which have been quantified amount to several billions of dollars annually. For example, the New England River Basin Commission has estimated that the cost of damage from acid deposition in New England and the Adirondack region of New York alone amount to $165 to $650 million a year in terms of effects on recreational fishing, materials, and forest products.

One estimate of potential acid rain damage in the State of Minnesota puts the tally for this State in the range of $623 to $823 million, considering impacts on fishing and tourism, corrosion of materials, reductions in forest productivity, losses of soil fertility, and impaired human health.

On the other hand, the most reliable current estimates we have seen of the cost of controlling acid rain indicate that the costs are fairly moderate, especially in relation to the cost of not controlling this problem.

ICF, Inc., the same contractor used by EPA, DOE, and the National Commission on Air Quality, reported within the past 3 months that legislation such as the Mitchell-Stafford Acid Deposition Control Act, S. 1706, which we strongly support, would result in an average annual increase in eastern utility rates of only 1.9 percent in 1990, with the largest State rate changes amounting to no more than 7.4 percent in some of the areas of heaviest sulfur dioxide generation.

We have heard and seen wildly extravagant utility industry estimates which claim that utility bills could increase by as much as 50 percent or more if acid rain controls are enacted. In general, these claims to the extent they can be supported at all represent projected impacts of unrepresentative, individual utilities which assumed the use of the most expensive possible methods of reducing SO_2 emissions.

Almost invariably these estimates assume that costly stack scrubbers will have to be installed and ignore the fact that S. 1706 encourages free interstate trading of emission reduction credits and permits the use of coal washing, low sulfur coal, energy conservation measures, least emissions dispatch, and substitution of controls on nitrogen oxides for SO_2 controls on a 2-to-1 basis as means among others of keeping emission control cost to an absolute minimum.

Mr. Chairman, the National Commission on Air Quality, the National Academy of Sciences, the International Joint Commission, the Council on Environmental Quality, the Department of State, the United States-Canada Scientific Work Group on Transboundary Air Pollution, the United States-Canada Research Consultation Group, et cetera, et cetera, have all called for immediate action to control the manmade sources of acid rain.

Our Government—as the two Senators have indicated—has unfortunately been less than diligent in pursuing control measures within the United States.

In conclusion, the Mitchell-Stafford bill which would mandate a 40- to 45-percent reduction in SO_2 emissions in the 31 Eastern States at the cost of less than a 2-percent increase in utility rates, is a moderate, much needed bill which deserves the support of this subcommittee.

The causes and effects of acid rain are sufficiently known. We know how to significantly reduce it at a moderate cost. We believe the time for action is now.

Thank you for the privilege to appear before this subcommittee.

[Mr. Kamlet's prepared statement follows:]

PREPARED STATEMENT OF KENNETH S. KAMLET

Mr. Chairman and Subcommittee Members: Thank you for the opportunity to appear before this Subcommittee on the important subject of acid rain. I am Director of the National Wildlife Federation's Pollution and Toxic Substances Division and appear here on behalf of the Federation's 4.6 million members and supporters throughout the United States (and our 53 state and territorial affiliates).

We would like to commend you, Chairman Pressler, and members of the Subcommittee for holding hearings on this issue. Not only is the unresolved problem of acid rain a thorn in the side of United States-Canada relations, but it is a problem which threatens serious environmental and economic damage in many parts of the United States. It is critically important that we bring this problem under control—not as an act of charity to our Canadian friends, but as a matter of vital U.S. self-interest.

In this regard, the proposed "Acid Deposition Control Act" (S. 1706), introduced on October 6th by Senators Mitchell and Stafford and ten other Senators, and currently co-sponsored by some 20 Republicans and Democrats, is a piece of legislation which (with perhaps a few refinements) deserves the support of every Member of the Senate.

It is unfortunate in the extreme that the Executive Branch of the U.S. Government has thus far adopted a posture—both in the context of pending revisions to our domestic Clean Air Act and in relation to bilateral United States-Canada negotiations—of blissful obliviousness to the urgent need to begin bringing the acid rain problem under control.

My testimony will document the need for acid rain control action and specifically the need to adopt control legislation such as S. 1706 and to expeditiously conclude an acid rain agreement with the Canadians. But first, some background.

BACKGROUND ON THE STATUS OF UNITED STATES-CANADA ACID RAIN NEGOTIATIONS

Current efforts to negotiate a bilateral United States-Canada agreement on acid rain are an outgrowth of two initiatives: a "Joint Statement or Transboundary Air Quality," issued on June 26, 1979, and a Memorandum of Intent (MOI), dated April 5, 1980. Both documents reflected an agreement on the part of the United States and Canada to work toward the swift negotiation of a Transboundary Air Quality Treaty; to provide increased advance notification of proposed actions involving risk of transboundary air pollution; and to further develop exchanges of scientific studies, cooperative monitoring programs and research on pollution control technologies.

Formal negotiations under the MOI began in Washington on June 23, 1981. A second meeting was held in Ottawa on November 6th. A third meeting, at which it is hoped a set of working principles can be developed, is scheduled to be held in Washington on February 24th.

Even prior to issuance of the MOI, the two governments in 1978 established a bilateral Research Consultation Group (RCG) on the Long Range Transport of Air Pollutants (LRTAP) as a step toward United States/Canadian cooperation under the larger U.N. Convention on International Air Pollution, prepared by the Economic Commission for Europe. The RCG had published two reports—one in 1979, one released on November 17, 1980—which confirm that acid rain is an international issue that should be addressed cooperatively.

A series of bilateral Working Groups was subsequently established under the MOI, including an "Impact Assessment Work Group" (Work Group 1); an "Atmospheric Modelling Work Group" (Work Group 2); and an "Engineering, Costs and Emissions Work Group" (Work Group 3B). Phase I "Interim Reports" were issued by these Work Groups in February 1981. Phase II reports were issued by Work Groups 1 and 2 in January 1982. The final Work Group submissions, a set of Phase III reports, are due to be submitted to the "Coordinating Committee" (i.e., the negotiating teams) by March 31 of this year. These reports are then to be subjected to "peer review" by the two governments. It has been decided as a policy matter in the U.S. side that the President's Science Advisor (and the Office of Science and Technology Policy, OSTP) will coordinate this peer review. (It has been suggested in at least one quarter that OSTP was given this role so as to be in a position to "appoint individuals to serve on the review panel who are more sympathetic to the Administration's political point of view and less concerned with the scientific validity of the document," Chemical & Engineering News, Dec. 21, 1981, p. 16; Administration sources have denied this, insisting that their only interest is in ensuring a credible and scientific review.)

LEGAL IMPERATIVES

The Memorandum of Intent signed by Canada and the U.S. represents a commitment by both countries not only to enter into formal treaty negotiations, but also to take interim action under existing law to combat acid rain, and to vigorously enforce existing law. (A report by the Sub-committee on Acid Rain of the Canadian House of Commons has stated that: "The United States should be reminded periodically that we in Canada feel bound by this Memorandum and we expect a reciprocal commitment from the United States, notwithstanding a change of Administration. To put any other interpretation on this document would jeopardize future negotiations between our two countries. We have treated our obligations seriously under this. . . . To date it appears that the United States is not approaching the problem in the same spirit." Still Waters, 1981, p. 92.)

The record so far, unfortunately, is not very encouraging. The Carter Administration proposed major legislation in 1980 to shift some oil-fired generating plants to coal. Despite the acknowledged consequence that such a step would substantially increase sulfur and nitrogen oxide emissions (Major acid rain precursors) along the Canadian border, Canada's concerns were ignored.

During the last 2½ years, EPA has approved dozens of relaxations of State Implementation Plans under the Clean Air Act, almost all of which result in increased sulfur and nitrogen oxide loadings (which in turn contribute to acid rain in the eastern United States and Canada).

EPA has also granted numerous approvals for the construction of tall stacks which greatly increase the long-range transport of pollutants, adding to the transboundary acid rain problem.

More recently, the current Administration, has steadfastly refused to initiate or support legislative measures in the United States to control acid rain—despite the endorsement of such steps by the bipartisan National Commission on Air Quality (set up by the U.S. Congress in 1977 to examine the need for revisions to the Clean Air Act) and the prestigious National Academy of Sciences. Instead, the Administration has adopted a more-research-no-action, stance (at the same time, not providing the budget and staff necessary to carry out the research said to be necessary.

Well before the advent of the MOI, the Trail Smelter Arbitral Tribunal stated the applicable principle of international law in its 1941 final decision:

> No state has a right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the persons or property therein, when the case is of serious consequence and the injury is established by clear and convincing evidence.

Principle 21 of the 1972 Stockholm Declaration of the United Nations Conference on the Human Environment affirmed that:

> States have, in accordance with the Charter of the United Nations and the principles of international law . . ., the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

The 1981 response of the U.S. Department of State and the Council on Environmental Quality to The Global 2000 Report to the President concluded that, "To reduce the threat caused by acid precipitation, the United States should [inter alia] . . . [g]o forward on work between the United States and Canada under the Memorandum of Intent to control transboundary air pollution. This work includes negotiation of a bilateral agreement as soon as possible." Global Future: Time to Act, January 1981, p. 141.

The Seventh Annual Report of the United States-Canada International Joint Commission (IJC) on Great Lakes Water Quality concluded that:

> . . . [T]he significance of atmospheric pollution to Great Lakes water quality as reported by the Great Lakes Water Quality and Science Advisory Boards, compel the Commission to advise the Governments of the extent and possible consequences of the acid rain problem in the Great Lakes Basin ecosystem. In this regard, the Commission believes that the potential for impacts on the Great Lakes is sufficient to require consideration of this problem under the provisions of Article VI(1)(e) of the 1978 Great Lakes Water Quality Agreement. . . . The Commission recommends that the Governments of the United States and Canada consult in a timely manner on appropriate actions to substantially reduce atmospheric emissions of sulphur and nitrogen oxides from existing as well as new sources, and that the Governments ensure . . . measures for the control of the long-range transport of airborne pollutants, with special attention in the near future to acid rain. (Report, October 1980, p. 55.)

The Great Lakes Water Quality Agreement commits the parties to developing and implementing as soon as practicable programs and other measures directed toward the achievement of the Agreement's water quality objectives. It also mandates the enactment of any additional legislation that may be necessary in order to implement such programs and measures.

Finally, under Section 115 of the Clean Air Act, the EPA Administrator is required to notify responsible states that revisions are required to their State Implementation Plans, upon receipt of reports, surveys, or studies from a duly constituted international agency indicating that U.S. emissions are causing or contributing to endangerment in a foreign country. In response to a December 23, 1980, request from Senator Mitchell (Exhibit 1), former EPA Administrator Costle on January 13, 1981, formally determined (Exhibit 2) that the IJC's Seventh Annual Report on Great Lakes Water Quality, and its conclusions and recommendations regarding transboundary air pollution, served to fully meet the prerequisites of Section 115:

> The International Joint Commission which is a duly constituted international agency under Section 115, has recently transmitted a report which addresses the issue of acid deposition. My review of the October 1980 Seventh Annual Report on Great Lakes Water Quality of the International Joint Commission (IJC) leads me to conclude that the IJC has found acid deposition results in significant harm in both the United States and Canada and that emission sources in both the United States and Canada contribute to the problem through the long-range transport of air pollution . . . .
>
> Finally, the IJC recommends in the Report that the Governments of the United States and Canada, "undertake further actions to reduce atmospheric emissions of the oxides of sulfur and nitrogen from existing as well as new sources." (Report at 5.)

The Administrator also concluded that another prerequisite of Section 115 action—that Canada "has given the United States essentially the same rights" with respect to emission sources in Canada as is provided by Section 115—had likewise been met (by Section 21.1(1) of legislation approved by the Canadian Parliament on December 17, 1980).

Unfortunately, the current EPA has done nothing to implement the mandatory directives of Section 115, despite the triggering determinations of more than a year ago.

In short, despite strong evidence (discussed in the next section) that air emissions originating in the U.S. are causing serious environmental and other damage in Canada, as well as in the United States, and despite the clear legal obligation (on both the United States and Canada) to take prompt action to control and remedy this problem, the U.S. Government has, by all indications, responded by dragging its feet. Indeed, the U.S. Government has systematically opposed congressional efforts to legislatively mandate even limited acid rain controls, and has repeatedly initiated actions with the inevitable effect (if not intent) of compounding and exacerbating an already alarming acid rain problem.

By letter of February 26, 1981, seventeen U.S. environmental and conservation organizations, including the National Wildlife Federation, wrote Under Secretary of State Buckley (Exhibit 3) to reiterate our recommendation that the U.S. Government pursue five steps to meet its international and domestic responsibilities to control acid rain. Secretary Buckley's response of May 18, 1981 (Exhibit 4), while acknowledging that the acid rain problem "is genuine and serious," stopped short of providing any indication that the United States was prepared to take any interim steps to begin controlling acid rain while the long process of negotiating a formal acid rain agreement with Canada continues.

The National Wildlife Federation believes that this inaction ill-serves the best interests of the United States.

DOCUMENTING THE NEED FOR CONTROL ACTION

A great deal of controversy surrounds the acid rain issue. This debate centers around whether there is enough evidence about the causes and effects of acid rain to justify action at this time or whether further research is needed before any sound decisions can be made. While there obviously are still uncertainties in the scientific understanding of the acid rain phenomenon, complete knowledge is never attainable. For example, we will probably never be able to say that the emissions from a particular powerplant are killing the fish in a particular lake. However, the National Wildlife Federation agrees with a growing number of scientists and statesmen that we cannot wait for a perfect understanding of the acid rain problem before moving to control it.

As was pointed out by a Member of the Canadian Parliament in a speech in November 1980:

> If we had waited back in 1972 for a complete understanding of the effects of phosphorus on the Great Lakes before starting our joint clean-up program, we would still be waiting and Lake Erie would be irreversibly dead. We know that we have been badly abusing some of our most precious natural resources and that abuse must be stopped. How many more lakes have to die before we get the message? (Roger Simmons, MP; excerpt reprinted in How Many Lakes Have to Die?, Canada Today/D'Aujord'Hui, Vol. 12, No. 2, February 1981, p. 11.)

Acid rain is caused by emissions of sulfur oxides and oxides of nitrogen. These pollutants are often transported far from their points of origin, transformed in the atmosphere into acids, and deposited hundreds (and even thousands) of miles downwind. Large coal-fired powerplants are the major sources of acid rain-causing pollutants in the eastern half of the United States. Smelters are the largest sources of such pollutants in the West. Huge amounts of SO_2 (sulfur dioxide) and NO_x (nitrogen oxides) are often projected up to 2,000 feet high into the air by tall smokestacks.

The ratio of United States to Canadian SO_2 emissions in the East is 5.5 to 1 (25 million tons versus 4.5 million tons). The bulk of the increase in U.S. emissions of SO_2 between 1950 and 1965 (where the level has stabilized) was in the southeastern and midwestern states. Thermal powerplants are the primary source of SO_2 in North America and contribute about 60 percent of the combined United States-Canada nationwide emissions. In the United States about two-thirds of total domestic emissions come from powerplants, while in Canada about 40 percent come from non-ferrous smelters. (U.S.-Canada Work Group, Phase I Report, pp. 12–13).

The idealized "clean atmosphere" pH (acidity) of rainfall is 5.6. (There is evidence that the average hemispheric precipitation pH value in North America may now be closer to 5.0. Work Group 2, Phase II Report [No. 2–15], p. 5). However, "a significant region of Eastern North America is experiencing an average annual precipitation pH of less than 4.2. . . . " (Id.). This is some 25 times more acid than natural rain. "The zone of maximum acidity in Eastern North America stretches in a corridor through Ohio and Pennsylvania into Southern Ontario." (Id., p. 6).

"Nowhere . . . are pH values in remote areas as low as those found in the most acidic precipitation areas of the northeastern United States and western Europe. . . . [T]here is a large contiguous area in eastern North America containing about 90 monitoring stations reporting annual average pH less than 4.6 and as low as 4.1. The latter value represents an increase in acidity by a factor [of] 30 above that in 'clean' rain, and clearly shows the regional influence of the concentrated man-made emission sources." (U.S.-Canada Work Group 2, Phase II Report [No. 2–14], p. IV–25).

The major cause of acid rain in eastern North America can no longer be seriously disputed. For example, a report issued by the prestigious National Academy of Sciences (NAS) last September ("Atmosphere-Biosphere Interactions: Toward a Better Understanding of the Ecological Consequences of Fossil Fuel Combustion," September 1981) concluded that: "The increased emissions of sulfur and nitrogen compounds from anthropogenic sources is the only plausible explanation for acid deposition" (p. 142), and that the evidence for the role of powerplant emissions in the production of acid rain is "overwhelming" (p. 3).

Although inconsistent and questionable data sets and gaps in collected information make it impossible to unequivocally correlate increased SO_2 emissions since 1955 with increased precipitation acidity, the existing data do seem to "fairly well substantiate" the areal spread of acidity west and south during this period. (U.S.-Canada Work Group 2, Phase II Report [No. 2–14], pp. II–11, II–16; Second Report of U.S.-Canada Research Consultation Group, October 1980, p. 1). It was, presumably, increased reliance on tall stacks to disperse sulfur and nitrogen oxide emissions that has served to greatly expand the areas of North American land and water subject to the deposition of abnormally acidic precipitation and particulate matter.

Some U.S. industries continue to take advantage of the past failures of both government and industry to monitor more thoroughly, and continue to claim that the increase of acid rainfall in North America has not been proved. Not only do these claims ignore the evidence cited above, but they also fail to recognize that where there has been comprehensive monitoring—as in Norway and Sweden, where the damage is more advanced and tens of thousands of lakes and rivers are dead as a consequence of acid rain—the results clearly show that acid rain has increased as transported sulfur and nitrogen oxide emissions have risen.

The 1981 NAS Report cited earlier concluded that, at current rates of emission of sulfur and nitrogen oxides, the number of North American lakes affected by acid rain can be expected to "more than double" by 1990, and to include larger and deeper lakes (p. 3). Continued emissions of sulfur and nitrogen oxides at these rates, in the Report's view, "in the face of clear evidence of serious hazard to human health and to the biosphere," will be "extremely risky" from the standpoint of long-term economic considerations as well as biosphere protection (id., p. 3).

ACKNOWLEDGEMENT OF THE NEED FOR ACID RAIN CONTROL

The United States-Canada International Joint Commission has urged "appropriate actions to substantially reduce atmospheric emissions of sulphur and nitrogen oxides from existing as well as new sources. . . ." (Seventh Annual Report on Great Lakes Water Quality, October 1980, p. 55).

Ninety Members of the United States Congress, in a 1980 letter to the Subcommittee on Acid Rain of the Canadian House of Commons, pledged their support to work with the Canadian government in providing solutions to the acid rain problem, noting that, despite unanswered questions, "we must take every reasonable step to control acid rain before all the evidence is in." (October 16, 1980, letter from Hon. Richard L. Ottinger, to Ron Irwin, M.P., Chairman, Sub-committee on Acid Rain, Standing Committee on Forestry and Fisheries, Canadian House of Commons; reprinted in: Still Waters, Oct. 15, 1981, p. 93).

The bipartisan National Commission on Air Quality, established by Congress under the 1977 Clean Air Act Amendments, concluded that: "Congress should require a significant reduction by 1990 in the current level of sulfur dioxide emissions in the eastern United States" and "should consider whether to adopt a phased program requiring interim reductions by 1985." (NCAQ Report, 1981, Recommendation No. 97, pp. 64–65). The Commission also recommended strengthening of the interstate pollution abatement provisions of Sections 110(a)(2)(E) and 126 of the Clean Air Act (Recommendation No. 92, p. 64); consideration of whether to enact a moratorium on relaxing existing sulfur dioxide emission limits in state implementation plans, unless it can be shown that undue economic or other hardship would result from retaining current limits; and consideration of whether conversion of utilities to coal should be accompanied by measures to prevent a net increase in SO_2 emissions (Recommendation No. 69, p. 64).

The Subcommittee on Acid Rain of the Canadian House of Commons recommended last year that Canada and the United States "reach an agreement on the necessary legislation and mechanisms to substantially reduce trans-boundary air pollution, particulary as it relates to acid rain, by the end of 1982. . .," but urged the United States "to improve its legislation, regulations and enforcement now so that acid rain-causing emissions will be substantially reduced, and that it not await the signature of a transboundary air pollution agreement." (Still Waters, Oct. 15, 1981, p. 92).

The Phase I Report of the U.S.-Canada Work Group on Transboundary Air Pollution concluded that "what is known about acid deposition indicates that the problem is genuine and serious" and that, if allowed to go unchecked, it "could result in substantial economic and social costs." It stated further that, "[a]s a practical matter, the best way to reduce acid deposition effects is to reduce emissions of pollutants that cause the problem"; that, "[t]o this end, interim actions could be sought in the near term"; that "[s]hort-term mitigating measures also could be considered"; and that "new legislation will likely be required to fully and expeditiously address this problem." The January 15, 1981, transmittal letter to this Report noted that, while "[f]urther research must obviously continue . . ., solutions should be sought in the near term." (Interim Report of Work Group 3A, Strategies Development and Implementation, February 1981, p. 9).

The U.S.-Canada Working Group on Impact Assessment, in its Phase II report, concluded that achieving levels of wet sulphate acid rain loadings which would be protective of moderately sensitive lakes "may require a reduction in sulphate deposition of more than half." (Phase II Report of Work Group 1, October 1981, p. 1–3).

A 1981 Report to the President by the Council on Environmental Quality and the Department of State on Global Resources, Environment and Population, recommended that the United States should: "[g]o forward on work between the United States and Canada under the Memorandum of Intent to control transboundary air pollution"—including "negotiation of a bilateral agreement as soon as possible"; and "[i]ntensify efforts under the Clean Air Act or other legal authority to control acid deposition . . .," with "amendments to the Clean Air Act" possibly "required to increase EPA's ability to address acid deposition and the regional air quality degradation caused by long-range transport in an efficient and equitable manner." (Global Future: Time to Act, January 1981, pp. 141–142).

The official position of the Government of Canada is that "we cannot wait for a perfect understanding of the acid rain phenomenon before moving to control it" and that "we know enough now to see that action to reduce the pollutants [that cause acid rain] is required immediately." "How Many More Lakes Have to Die?" February 1981, pp. 6, 11).

The National Academy of Sciences concluded in its 1981 Report that "the picture is disturbing enough to merit prompt tightening of restrictions on atmospheric emissions from fossil fuels and other large sources. . ." (p. 7); that, of the available options, only the control of SO_2 and NO_x emissions can significantly reduce the rate of deterioration of sensitive freshwater ecosystems (p. 181); that control of SO_2 from new powerplants alone would be insufficient to significantly reduce these acid rain impacts, so restrictions on older plants must be considered (p. 181); and that a significant reduction in the rate of deterioration of sensitive freshwater ecosystems would require a reduction in precipitation pH levels to "values no lower than 4.6 to 4.7," which would mean "a reduction of 50 percent in deposited hydrogen ions" in the most seriously affected areas (p. 181).

The U.S.-Canada Research Consultation Group concluded in its first report, in 1979, that: "In view of mounting evidence of serious and continuing environmental degradation in eastern North America as a result of acidification, it should be recognized that delays in undertaking action to address the presently deteriorating situation will result in greater damage and possible economic costs in the future." (RCG, 1st Report, 1979, p. 25.).

Some 38 acid rain scientists, polled at random by NWF in selected states, have endorsed the view that "what is already known about [the acid rain] phenomenon amply justifies and requires immediate legislative steps to begin abating emissions of human generated acid rain precursors." A copy of the full acid rain position statement and a list of the 38 signators lined up to date is attached as Exhibit 5.

IMPACTS OF ACID RAIN

The existing and potential impacts of acid rain are real and profound and the trends are ominous.

Contrary to the contentions of those who wish to close their eyes to the problem, acid rain poses a serious threat to most of the eastern United States and to a growing number of states west of the Mississippi River. The National Wildlife Federation has compiled a series of maps showing the distribution of low-pH rainfall and acid-sensitive soils and lakes in the 27 states east of the Mississippi River. These maps are based on recent studies of surface water alkalinity, bedrock geology, soil chemistry, soil type, and rainfall pH data collected from 1976–1980. By superimposing the maps of sensitive soils and surface waters on a map of U.S. Congressional Districts, those districts which may be most seriously impacted can be readily identified. Two of these maps are attached to my testimony as Exhibits 6 and 7.

Far from being a problem confined to the Adirondack region of New York, areas of the United States which may be profoundly affected by acid deposition include at least 15 eastern states and upwards of 100,000 miles of streams and 20,000 lakes.

NWF has also evaluated the acid rain sensitivities of the 27 eastern states in relation both to environmental impacts and materials damage. Our analysis showed that fully 15 of the eastern states must be regarded as extremely vulnerable to acid rain—including Maine, New York, Rhode Island, Vermont and West Virginia. We used data from current acid rain studies, from precipitation monitoring stations and from personal communications with scientific experts to rank these 27 states according to their vulnerability to fishery, soil, crop foliage, and masonry damage. Visibility and automobile paint damage were also considered—although these are measures of actual rather than potential impacts. A summary of our acid rain vulnerability report ("Acid Rain Vulnerability of the 17 States East of the Mississippi River") is appended as Exhibit 8.

There appears to be mounting evidence of acid rain impacts and vulnerability in a growing number of western states. For example:

Minnesota: receives a mean rainfall pH of 4.6–4.8, with individual storms as low as 3.6 (100 times more acidic than normal rainfall). Acid sensitive lakes are distributed throughout the central and northeastern parts of the State with damage occurring to 15 percent of the lakes and another 2,600 in immediate jeopardy. Beginning effects of acidification are being observed in lakes in the Boundary Waters Canoe Area in Voyageurs National Park in Minnesota. It has been estimated that acid rain impacts in Minnesota could reach $78 million a year for fishing and tourism, $40 million for corrosion of man-made materials, $65 million a year for reduced forest productivity, upwards of $400 to $600 million annually in lost soil fertility, and $40 million a year in human health costs.

Colorado: rainfall pH in Boulder has declined from 5.43 to 4.63 (a 6-fold reduction) over a 3-year period. Measurements taken during 1980 near Crested Butte reportedly showed a high acid level in small lakes and streams in the Elk Mountains.

Wyoming: average precipitation pH recorded in Yellowstone National Park in 1980 was 5.2 (2½ times as acid as normal rain).

Montana: average pH of precipitation in Glacier National Park is 4.9, with values as low as 4.4.

Oregon: rainfall pH values as low as 4.1 (over 30 times more acid than normal) were recorded at the Schmidt Farm monitoring station.

Arizona: pH values as low as 4.1 were recorded at the Cochise monitoring site in 1979. In 1980, the average pH recorded in Tombstone was 5.2.

Nebraska: precipitation pH values as low as 4.3 were found in Lancaster County in 1979.

New Mexico: precipitation pH values in the 3's and 4's have been reported in the Teseque watersheds in the Sante Fe National Forest.

California: rainfall pH values as low as 2.9 were reported in 1978. 1980 values as low as 3.9 were found in Yolo County.

Idaho: the 1980–81 pH average at Craters of the Moon National Monument was 4.8

Washington: 24 to 68 lakes sampled in the Olympic Mountains and the Cascades had a pH of less than 6; 7 had a pH of less than 5.5 (all in the Alpine Lakes Wilderness due east of Seattle). 70 percent of the rainfall monitored in Seattle ranged in pH from 5 2 to 4.2.

Excerpts of a recent Sports Illustrated article on acid rain, listing acid rain impacts of a number of vulnerable states were inserted in the Congressional Record by Senator Dodd—127 Cong. Rec. S11233–11235 (Oct. 7, 1981).

The best documented impacts of acid rain in the United States can be summarized as follows:

A. Aquatic Impacts

"Sulphuric acid has been identified as the dominant compound contributing to the surface water acidification process. Studies of lakes in Eastern North America have provided strong evidence that it is atmospheric deposition that accounts for the elevated sulphate levels of surface waters." (Work Group 1, Phase II Report, pp. 1–2).

"Trend analyses in acidification of streams and lakes date back 17 years in New Jersey and forty years in the Adirondacks and show a marked decline in pH values . . . A recent inventory has indicated that at least 180 former brook trout ponds [in the Adirondacks] will no longer support trout because of acidification." (Id.).

In Nova Scotia, the pH in a number of salmon spawning rivers has shown a marked decline from 1954–55 to the present, with a concurrent statistically significant decrease in angling success. The decrease in pH has been attributed to an increase in sulphate loadings from anthropogenic sources. (Id.).

"Many changes in aquatic life have been linked to acidification . . . [A]cidification has [generally] been accompanied by decreases in species richness and changes in species dominance. Acidification results in changes in the makeup, size and metabolism of plankton communities. These alterations hold important implications for other organisms higher in the food chain. (Id.).

The pattern of sulphate concentrations in surface waters in Eastern North America, when considered in conjunction with the measured wet deposition of sulphate, provides "strong evidence that the atmospheric deposition from long-range transport accounts for the elevated sulphate levels of the surface waters." (Id., pp. 3–39).

The data show that 38–81 percent of lakes and streams in the Eastern U.S. fall in the categories of moderately sensitive to acid rain to already acidified. (Id., pp. 3–48).

Thirteen to 48 percent of midwestern lakes are in the same categories. (Id.).

Nine out of eleven lakes sampled in Northern Florida were acidified. (Id.).

Northern areas of Minnesota, Wisconsin, and Michigan are potentially susceptible to acid deposition. "The region's rich resources and related industries, including recreation, forestry, farming, and mining, would be vulnerable to disruption of acid inputs reached levels presently being experienced in other areas of the United States." (Id.).

Half the lakes in the Boundary Waters Canoe Area Wilderness in Minnesota are susceptible to acidification. (Id.).

Wisconsin has 2,600 vulnerable lakes with a pH at or below 6.0 with little or no alkalinity. (Id.).

Michigan has more than 10,000 lakes over 4 hectares in size, and susceptible to acidification. Of some 8,000 lakes and ponds in the western half of the upper peninsula of Michigan, more that 50 percent have an alkalinity in the range of 10 mg/1, indicating that they are potentially susceptible to acid inputs. (Id., pp 3–48, 3–50).

More than 630 lakes and streams, from Maine to Minnesota, have been shown to be acidified, or to be moderately or extremely sensitive to acidification:

PERCENTAGE OF LAKES AND STREAMS IN VARIOUS SENSITIVITY CLASSES

Region	Percentage of lakes and streams sampled			
	Acidified	Extreme sensitivity	Moderate sensitivity	Total
Lakes:				
Adirondack	23(99)	17(73)	40(173)	80
North Wisconsin	3(08)	20(55)	19(52)	42
North Minnesota			48(41)	48
Streams:				
Northwest Pennsylvania	11(02)	11(2)	39(7)	61
East Pennsylvania		19(5)	19(5)	38
Connecticut	4(1)	4(1)	48(11)	56
Maine		6(1)	75(12)	81
North Carolina and Virginia		5(2)	59(22)	64
Jackson County, Wisconsin		8(6)	35(28)	43
Oneida County, Wisconsin		2(4)	11(21)	13
Total	(110)	(149)	(372)	

Source: Id., p. 3–49.

Of 218 high-elevation lakes of the Adirondack region of New York measured in 1975, approximately 50 percent were significantly more acid in comparison to earlier observations in 1935. All surveyed lakes are very sensitive to acidification, and many are already acidified. (Id., p. 3–53.)

Overall, 7.9 percent of the lakes in the Adirondack (228 lakes) were found to be acidified in 1975 to 1979 surveys; about 25 percent of the lakes were at a "critical" pH level, below 5.0. (Id.).

Summer pH measurements for 1,368 lakes in Maine, over the period from the 1930's to the 1970's, show an eight-fold increase in acidity (from pH 6.85 in 1937 to about 5.95 in 1974). Roughly three-quarters of this increase occurred between 1950 and 1960, corresponding to the period in which the acidity of precipitation may have increased most rapidly. (Id., p. 3–58.)

A preliminary analysis of 300 headwater ponds and streams in the six New England states found that alkalinity readings indicative of high sensitivity to acidification cover most of the regions examined. (Id.).

A 17-year, statistically significant, trend toward acidification of headwater streams in the New Jersey Pine Barrons (which drain relatively undisturbed watersheds) has been described, possibly attributable to increasingly acid precipitation in southern New Jersey. (Id., p. 3–58.)

Thirty-eight streams in western North Carolina showed a decrease in pH and alkalinity in 80 percent of the streams surveyed between 1960–63 and June and July, 1979. Mean hydrogen ion concentrations (acidity) increased by 82 percent. (Id., p. 5–6.)

"Scandinavian and North American studies appear to agree on one point: acidification of sensitive waters is detectable within one to two decades where pH values of precipitation are less than 4.6—a 10-fold increase in acidity over the theoretical 'pure' rain pH value of 5.6. In areas where precipitation has pH values of 4.0 to 4.3, degradation is much more rapid." (NAS Report, September, 1981, p. 153.)

B. Terrestrial Ecosystem Impacts

Several studies have demonstrated the direct effects of acid deposition on soils. (Work Group 1, Phase II Report, pp. 1–3, 4–1).

Forested areas are especially vulnerable to significant loss of nutrients due to acid deposition because: (a) forested areas are generally associated with areas of lower pH soils with low nutrient status; (b) forested areas are traditionally much less heavily managed than agricultural areas, in terms of such practices as liming and fertilization; and (c) new harvesting technology, which removes more of the tree from the site, reduces the availability of nutrients for recycling. (Id.).

Field and laboratory studies have already provided extensive documentation of the direct effects of sulfur dioxide and ozone (a byproduct of hydrocarbons and nitrogen oxides) on vegetation. (Id., p. 4–1).

"Increases in acid deposition, it is postulated, could result in accelerated changes in the natural evolution of soils, leading to alterations in soil fertility over the long term. Such alterations in soil chemistry could have detrimental implications for long term sustained agricultural and forest productivity. In addition, it could have an important implication for, and linkage with, aquatic sensitivity." (Id., p. 4–2).

Eleven different types of potential injuries resulting from direct exposure of plants to acid precipitation have variously been suggested. (Id.).

"Experimental evidence from studies of the action of acid precipitation on tree parts . . . indicate(s) . . . that, under regimes of high acid dosing, direct damage, such as foliar lesions, can be produced." (Id., p. 4–12).

"There are . . . reasons to be concerned that forests and some crops may be damaged with continued pollutant loadings." (U.S.-Canada Research Consultation Group, Report No. 1, 1979, p. 25).

"Much existing indirect data suggest acid loading will sooner or later lead to a reduction in . . . productivity [of eastern North American forests and agricultural crops] that would be very costly in socioeconomic terms and not feasible to remedy." (U.S.-Canada Research Consultation Group Report No. 2, 1980, p. 19).

Studies of the sensitivity of crops to simulated acidic precipitation showed that the foliage of 31 of 35 crop varieties examined was injured at pH 3.0. (Five were injured at pH 4.0). Yields were reduced for 5 crops; stimulated for seven; ambiguously affected for 2; and not significantly affected for 15. (Id., p. 18).

"Acid rain has particularly severe effects upon the cycles of metallic toxicants and nutrients, because of the influence of hydrogen ions upon cation exchange and weathering and the consequences of mobilizing various elements." (NAS Report, 1981, p. 170).

"The soils most susceptible to rapid acidification are well-drained brown forest soils (alfisols) that are sandy and noncalcareous but not already strongly acid." (Id., p. 172).

Both theoretical and experimental studies suggest that declines in cation exchange capacity and in calcium, magnesium, and potassium in soils "may be widespread in vulnerable soils after several decades to a few centuries of acid precipitation." (Id., p. 173).

"[L]ong term growth of forests in acid sensitive regions may be adversely affected by acid deposition among other factors" (Work Group 3A, Phase I Report, 1981, p. 6).

"Although the deposited nitrogen and sulfur may be slightly beneficial in terrestrial soils deficient in these elements, the stimulus is expected to be short-lived, and over the long-term acid precipitation is likely to accelerate natural processes of soil leaching that lead to impoverishment in plant nutrients." (NAS Report, 1981, p. 3).

C. Human Health Effects

"In areas subject to acid deposition, data on heavy metal migration into the food chain indicates an area of great concern. A correlation does exist between low pH in lakes and higher mercury concentrations in some species of fish, and further acidification may pose a threat to fish-eating birds and mammals." (Work Group I, Phase II Report, pp. 1–5).

"Acid deposition may liberate metals in some ground waters and drinking water supply systems. Evidence does exist where elevated metal concentrations in drinking water supplies have been found." (Id.).

"High mercury concentrations in fish from acidified waters have been reported from the United States, Norway, and Sweden." (NAS Report, 1981, p. 157).

D. Visibility Effects

"Analysis of airport data indicate[s] a substantial decline in regional summertime visibility, in eastern North America, between 1950 and 1974. This change may be associated with changes in the level and distribution patterns of sulphur oxide emissions." (Work Group 1, Phase II Report, 1981, pp. 1–6).

"Clean areas, such as those found in western North America, are the most sensitive to visibility degradation." (Id.).

E. Buildings and Structures

"There is considerable evidence that materials in urban areas of Europe and North America have suffered and are suffering from exposure to man-made pollutants. Such materials include statuary and structures of substantial cultural, historic and artistic value." (Work Group I, Phase II Report, 1981, p. 1-6).

The principal airborne pollutant adversely affecting materials is SO_2. (Id.). "It is reasonable to assume that acid deposition due to long range transport and transformation of air pollutants contributes somewhat to material effects." (Id.).

F. Irreversible Impacts

Advocates of more-research and no-action on acid rain frequently argue that we should not "rush to judgment", and that we have the luxury of sufficient time to delay acid rain control action until the results of additional acid rain research are in hand. The most serious flaw in this logic (apart from the availability of insufficient funding to allow needed research to be completed expeditiously) is that a number of the most drastic negative impacts of unchecked acid precipitation are cumulative and irreversible. Every year we delay means additional, incalculable damage to the environment and economy of eastern North America.

The Impact Assessment Working Group (Work Group I), in its Phase II Report (issued in October 1981) under the U.S.-Canada Memorandum of Intent on Transboundary Air Pollution, has identified three categories of acid rain damage which, for all practical purposes, may be regarded as "irreversible" (defined for natural resource systems as "an incomplete recovery to a prestressed or undamaged state over a few decades"):

1. Depletion of Buffering Capacity (pp. 3–107 and 3–110)

"The possibility of irreversible reduction in buffering capacity of lakes and watersheds is one of the most serious impacts of acid deposition. Once the proton-accepting materials, which hold pH in a biologically acceptable range, are lost from the soil water and stream base-flow, free H^+ [hydrogen ion] or its surrogate, Al^{3+} [aluminum ion], rise quickly to toxic levels, seriously weakening the biota." (p. 3–107). "The hypothesis that acidification of surface waters by atmospheric acid inputs can be viewed as a large-scale titration has been articulated by Henriksen (1980), and supported with data from North America and Scandinavia (Wright et al. 1980)." (p. 3–109.) "[T]he general pattern of observed responses is consistent with the known low buffering capacity of the geology and soils, and with present equilibrium theory for these systems. The effects can be reversed only by regeneration of buffering capacity over a period of unstressed geological weathering. The transition phase of lake acidification appears to be the last chance to halt acidification and allow normal acid-base equilibria to be established, with H^+ and Al^{3+} in a biologically tolerable range." (p. 3–110).

2. Soil Cation and Nutrient Depletion (pp. 3–110 and 3–112)

"A second, apparently irreversible, consequence of watershed titration is the loss of soil cations, particularly Ca^{2+} and Mg^{2+}, which can lead to decreases in soil fertility." (p. 3–110). Experimental evidence for acid-rain-associated cation denudation has been obtained by Likens et al. (1977) over an 11-year period at Hubbard Brook, New Hampshire, and by Harvey et al. (1981) "at a variety of watersheds in North America and Scandinavia." (p. 3–110). "If cation denudation depletes the stock of nutrients of easily weathered soil, decreases in fertility can result." (p. 3–112.)

3. Loss of Gene Pools (Unique Ecosystem Components) (p. 3–112)

"The most serious irreversible biological effect of acidic deposition is species extinction within sensitive regions. The organisms most threatened include amphibians, fish, crustaceans, molluscs and some aquatic insects. Elimination of fish populations in numerous water bodies has already occurred in Scandinavia, the Adirondacks and parts of Ontario. For these sensitive organisms, even a partial loss of populations bearing genetic characteristics intolerant to H^+, Al^{3+}, or heavy metals, can result in a relatively permanent mark on these populations. As geographic movement of these lacustrine [lake] life forms is limited, recovery of pre-stressed genetic characteristics probably can be considered only over millenia." (p. 3–112).

DESIRABLE ACID RAIN CONTROL LEGISLATION

Within the United States, the major documented causes and consequences of acid rain are localized within the eastern half of the country—a 31-state region east of and adjacent to the Mississippi River. The dominant precursor of acid rain in this region is sulfur dioxide, with coal-fired utilities being the principal generator of SO_2 emissions.

The National Academy of Sciences, in its 1981 report on Atmosphere-Biosphere Interactions, concluded that a reduction of 50 percent in deposited hydrogen ions would be required to significantly reduce the rate of deterioration of sensitive lakes and streams in the most seriously affected areas (p. 181). The most recent report of the U.S.-Canada Working Group on Impact Assessment (October 1981) concluded that it might well take "a reduction in sulphate deposition of more than half" in order to protect moderately sensitive lakes from wet sulphate loadings in acid rain (p. 1–3). (Dry deposition of sulphate might require additional output reductions).

A recent authoritative projection of the "Cost and Coal Production Effects of Reducing Electric Utility Sulfur Dioxide Emissions" (Nov. 14, 1981), prepared for the National Wildlife Federation and the National Clean Air Coalition, by ICF, Inc. (the same contractor used by EPA, the Department of Energy, and the National Commission on Air Quality), indicates that a 40 to 45 percent (10 million ton) reduction in SO_2 emissions in the eastern U.S. can be achieved by 1990 at an average increase in electricity rates of only 1.9 percent. Even in the major mid-Western SO_2-generating states, average electricity rate increases would not exceed 7.4 percent. A summary of the ICF analysis is appended as Exhibit 9.

Even in these troubled economic times, this is a very modest price to pay for avoidance of the catastrophic harm to health and the environment (right here in the United States) which would occur in the absence of effective controls on acid rain.

The proposed Acid Deposition Control Act, S. 1706, introduced by Senators Mitchell and Stafford, and currently co-sponsored by some 20 Republican and Democratic Senators, represents a significant first step in the direction of solving our acid rain problem. We enthusiastically support this bill and hope the Members of this Subcommittee will do likewise.

The key features of the Mitchell-Stafford bill can be summarized as follows. The bill would:

Establish a 31-state acid precipitation impact region, including the 27 states east of the Mississippi River plus Minnesota, Iowa, Missouri, and Arkansas;

Freeze sulfur dioxide and nitrogen oxide emissions at their January 1, 1981, level;

Require an annual reduction of 10 million tons in sulfur dioxide emissions in the 31-state region within 10 years (SO_2 is currently being emitted at the rate of about 23 million tons per year in these states; 28 million tons, nationwide) (each state's share to be determined based on utility emissions in excess of 1.2 lbs. of SO_2 per million BTU's);

Encourage free interstate "trading" ("bubbling") of emission reduction credits (as a means of cost minimization);

Require the EPA Administrator to conduct a study on the effects of acid rain in the Southwest, Great Plains, and Northwest;

Give states two years to determine how the reduction in SO_2 emissions will be accomplished by sources under their jurisdiction.

CONCLUSIONS AND RECOMMENDATIONS

Solution of the acid rain problem in the United States and Canada will require a concerted effort by the two countries over a sustained period of time. The first step is to admit that a serious problem exists and that the governments can do something about it. The second step is to determine what goals for reducing the offending emissions are appropriate, over a particular period of time. The third step is to allocate those reductions between the two countries and among the various regions, states and particular sources. We believe that solutions can be found which are equitable and cost-effective.

On the other hand, in light of the growing severity of the acid rain problem within the United States, it is imperative that the U.S. Government not defer the beginnings of control action until a bilateral treaty has been concluded with

Canada. It is especially critical that the U.S. Government avoid doing things which will compound and exacerbate the acid rain problem. Unfortunately, the current U.S. Administration (and to some extent the preceding Administration) has repeatedly initiated actions and pursued policies with the inevitable effect (if not the intent) of increasing the acid rain problem.

If the United States is serious about abating the acid rain problem, the time for action is now. Among the steps which must be taken, which we hope this Subcommittee will support are:

Requiring oil-fired generating plants that shift to coal to ensure no net increase in sulfur and nitrogen oxide emissions (particularly along the Canadian border);

A moratorium on further relaxations of State Implementation Plans, where such relaxations would produce increased sulfur and nitrogen oxide loadings;

Establishment of strict limits on approvals of new or modified tall stacks;

Adoption of acid rain control legislation, such as the Mitchell-Stafford bill (S. 1706);

Adoption of strengthening changes in the interstate pollution provisions of the Clean Air Act, of the sort proposed in the Dodd-Durenberger Bill (S. 1718); and

The expeditious conclusion of a bilateral acid rain control treaty between the United States and Canada.

We appreciate the opportunity to appear before this Subcommittee on the vital issue of acid rain control.

EXHIBIT 1

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, D.C., December 23, 1980.

Mr. DOUGLAS M. COSTLE,
Administrator, Environmental Protection Agency,
Washington, D.C.

DEAR DOUG: I have just learned that the Canadian Parliament has enacted legislation which provides essentially the same rights to the United States as this country provides to Canada under Section 115 of the Clean Air Act. In my view, this legislation satisfies the requirement of Section 115(c) that a foreign country provide reciprocal rights to this country as a prerequisite to action by the Administrator of EPA under Section 115. I believe that this legislation, in conjunction with findings made in the reports noted below, oblige you to take action under Section 115 to remedy the problem of acid precipitation emitted in the United States which is affecting Canada.

The reports I refer to are those you have received from the International Joint Commission on Great Lakes Water Quality, from the Great Lakes Water Quality Board of the International Joint Commission and from the United States-Canada Research Consultation Group on Long-Range Transboundary Air Pollution (RCG). I believe both the IJC and the RCG are duly constituted international agencies, as contemplated by Section 115(a). In July 1979, the Annual Report of the Great Lakes Water Quality Board recommended that the Governments of Canada and the United States undertake actions to reduce atmospheric emissions of sulfur and nitrogen oxides from existing and new sources, in order to reduce the effects of acid precipitations. Similarly, in October 1980, the IJC's Annual Report recommended that both Governments:

(1) consult in a timely manner of appropriate actions to substantially reduce atmospheric emissions of sulfur and nitrogen oxides from existing and new sources and (2) ensure that adequate, comprehensive research programs are underway to provide information on the causes, effects on the ecosystem, and measures for the control of long range transport of airborne pollutants, with special attention in the near future to acid rain.

EXHIBIT 2

U.S. ENVIRONMENTAL PROTECTION AGENCY,
Washington, D.C., January 13, 1981.

Hon. GEORGE MITCHELL,
U.S. Senate,
Washington, D.C.

DEAR SENATOR MITCHELL: Thank you for your letter of December 23, 1980 regarding Section 115 of the Clean Air Act. As you are aware, this Section of the law requires EPA, if certain conditions are met, to call on States to revise their implementation plans where necessary to prevent or eliminate endangerment to public health or welfare in a foreign country stemming from air pollutants emitted in the United States.

Two recent actions require me to consider whether EPA should identify appropriate States for notification under this Section. First, in October 1980, the International Joint Commission submitted its Seventh Annual Report on Great Lakes Water Quality. That report contains a section describing damages due to transboundary air pollution and a recommendation that the Governments of the United States and Canada act to reduce certain air pollutants. Second, on December 17, 1980, the Canadian Parliament approved legislation providing the Canadian federal government with powers to abate transboundary air pollution. On December 24, 1980, the U.S. Department of State issued a public statement committing the United States to evaluate whether this Canadian legislation provides essentially the same rights as are provided by Section 115 of the Clean Air Act. The Clean Air Act requires the Administrator of EPA to make this determination.

There are two principal conditions which must be met before EPA can notify a State under Section 115 that a plan revision is required. First, the Administrator on receipt of reports, surveys, or studies from a duly constituted international agency must conclude that U.S. emissions are causing or contributing to endangerment in a foreign country, or must have received a request from the Secretary of State to notify a State. Second, before the provisions of Section 115 can be applied with respect to a foreign country, the Administrator must determine that the country provides the United States with essentially the same rights regarding international air pollution control as are provided by Section 115.

Your letter calls attention to certain reports which discuss problems of transboundary air pollution between the United States and Canada. As you are aware, the major focus of U.S.-Canadian concerns in the past two years respecting transboundary air quality has been on the question of the adverse impacts of acid deposition.

As my public statements over the past year have indicated, EPA has concluded that acid deposition, often referred to as acid rain, presents a genuine threat to our environmental well-being both in the U.S. and Canada. What we know or suspect about acid deposition indicates that the problem is genuine and serious:

Acid deposition can and has destroyed lake and stream ecosystems, killing fish and other water life;

Many lakes in Canada and the United States are already acidified and their fish populations are shrinking or are extinct;

Some soils are being damaged over time due to leaching of minerals and nutrients;

The water and soils over extensive areas in North America are susceptible to acidification;

Stone buildings, monuments, and other building materials are eroded more rapidly by acid deposition;

Some important crops may be damaged by acid deposition and others may be injured by acidified soils;

Growth of forests may be reduced over time; and

Over the long term some drinking water supplies may be contaminated by toxic metals leached from the soil as a result of acid deposition.

These kinds of impacts are within the range of impacts covered by Section 115. As you know, that Section is broadly drafted to encompass all forms of air pollution-related endangerment to public health or welfare and is not limited to interference with U.S. air quality standards or significant deterioration programs as is Section 126 of the Clean Air Act.

The relative contribution of U.S. and Canadian emission sources to acid deposition problems in the U.S. and Canada varies widely from location to location. The stress to our ecosystems created by acid deposition is a function of the total atmospheric loadings of sulfur and nitrogen compounds. Surveys conducted over the past several years establish that there is a significant flow of these pollutants across the U.S.-Canadian border in both directions. Thus, we can say with some certainty that emission sources in the U.S. contribute significantly to the atmospheric loadings over some sensitive areas in Canada and that emission sources in Canada contribute significantly to the loadings over some sensitive areas in the United States.

Given our understanding of the impacts of acid deposition and of the joint contribution of U.S. and Canadian sources to the problem, I believe that the Section 115 authority could appropriately be used to develop solutions, provided that either the Secretary of State requests action or that any relevant reports of international agencies state the existence of the problem and that Canadian law and practice provide the U.S. with essentially the same rights respecting emission sources located in Canada.

The International Joint Commission which is a duly constituted international agency under Section 115, has recently transmitted a report which addresses the issue of acid deposition. My review of the October 1980 Seventh Annual Report on Great Lakes Water Quality of the International Joint Commission (IJC) leads me to conclude that the IJC has found acid deposition results in significant harm in both the U.S. and Canada and that emission sources in both the U.S. and Canada contribute to the problem through the long-range transport of air pollution. The IJC Report states that "[a]cidic precipitation is one widely known and serious example of a problem associated with the long-range transport of airborne pollutants." (Report at 49). The Report states that "[v]irtually all of eastern Canada and portions of the northeastern United States experience rains with acidity equal to or exceeding that which can adversely affect susceptible ecosystems. All parts of the Great Lakes watershed are now receiving precipitation containing 5 to 40 times more acid than would occur in the absence of atmospheric emissions. Many inland lake ecosystems in the most susceptible parts of the Basin may be irreversibly harmed within 10–15 years." (Report at 50). The Report also notes that "[a] substantial portion of the Great Lakes drainage basin is potentially susceptible to acidic precipitation, based on its bedrock geology. The Sudbury, Muskoka and Haliburton areas of Ontario and the Adirondacks of northern New York are among the most heavily impacted areas in the world because their geology offers little buffering capacity to their inland lakes. Some lakes in the Haliburton-Muskoka area have lost 40–75 percent of their acid neutralizing ability in a decade or less. These areas are now being subjected to precipitation which is twice as acidic as that which caused losses of major fish stocks in thousands of Scandinavian lakes." (Report at 50).

The Report points out "the massive and diffuse nature of the [emission] sources throughout eastern North America" (Report at 54) and notes that acid deposition often occurs "many hundreds of miles from the source." (Report at 50).

Finally, the IJC recommends in the Report that the Governments of the United States and Canada, "undertake further actions to reduce atmospheric emissions of the oxides of sulfur and nitrogen from existing as well as new sources," (Report at 5).

I have concluded that this report confirms my previously stated position that acid deposition is causing significant environmental problems on both sides of the U.S.-Canadian border due to emissions from U.S. and Canadian sources.

The question of whether Canada "has given the United States essentially the same rights" with respect to emission sources in Canada as is provided by Section 115 requires consideration of recently enacted Canadian legislation.

On December 17, 1980, the Canadian Parliament approved legislation which provides the Canadian federal government with authority to adopt emission standards for sources which contribute to air pollution related problems in another country. Specifically, Section 21.1(1) of the legislation provides that where the Minister of Environment has reason to believe that an air contaminant emitted by a Canadian source or sources creates or contributes to air pollution that may reasonably be expected to constitute a significant danger to the health, safety, or welfare of persons in another country, the Minister shall recommend to the Governor in Council (the highest federal executive authority) specific emission standards for the source or sources, in relation to the air contaminant, either alone or in combination with one or more other air contaminants, as he considers appropriate to eliminate or significantly reduce the danger. Under Section 21.1(2), if the Minister proposes a recommendation, the notice of the proposal is to be published in the Canadian Gazette. A reasonable opportunity to make representations to the Minister concerning the proposal is to be offered to persons in Canada who would be affected by the prescription of specific emission standards, and to the endangered country.

For sources other than "federal" sources, Section 21.1(3) in effect requires that before making a final recommendation the Minister must consult with the appropriate province and provide the province with an opportunity to eliminate or significantly reduce the danger to the other country.

Section 21.2(1) authorizes the Governor in Council to prescribe specific emission standards recommended by the Minister if the Governor in Council concludes that the foreign country considered in making the recommendation under Section 21.1(1) has provided for "essentially the same kind of benefits in favor of Canada with respect to abatement or control of air pollution as is provided in favor of the country" by the Canadian Clean Air Act. In order to prescribe a specific emission standard with respect to non-federal sources, the Governor in Council must conclude that reasonable efforts by the Minister to procure reduction or elimination of the danger by the provincial government, have been unsuccessful.

As with most legislation, it is possible that the Canadian legislation could in the future be interpreted or implemented in a way that the United States would conclude that it was not being given essentially the same rights as are provided under Section 115. Thus, it is not possible to make a permanently binding determination that Canada has given the United States essentially the same rights based simply on a review of Canadian authorizing legislation. EPA first determines that Canadian legislation gives ample authority to the Government of Canada to provide essentially the same rights to the United States. Second, EPA must determine that the Government of Canada is exercising or interpreting that authority in a manner that provides essentially the same rights to the United States. This second aspect of EPA's determination is necessarily a dynamic one which will continue to be influenced by Canadian action now and in the future.

In my view, the amendments to the Canadian Clean Air Act do give adequate authority to the Government of Canada to provide essentially the same rights to the United States as Section 115 provides to Canada. Both Section 115 and Sections 21.1 and 21.2 authorize a federal official to make a finding or recommendation concerning endangerment to health or welfare of a foreign country due to any air pollutant emitted domestically, and to prescribe specific emission limits to eliminate, significantly reduce, or prevent the endangerment. The Canadian legislation refers to "significant danger to the health, safety or welfare of persons," thus my conclusion assumes this phrase will be interpreted to have essentially the same coverage as the Section 115 phrase "endanger public health or welfare." Both statutes allow the State or province, as appropriate, to take actions to remedy air pollution affecting a foreign country. If the State or provincial government fails to develop an adequate remedy the federal government is authorized to establish emission limitations. Each statute also requires that the federal government provide opportunities for public hearing on any proposed action and participation in the hearing by an affected foreign government.

The principal difference in the two statutes is the detailed procedural and substantive requirements applicable to the State plan revision process under the U.S. Clean Air Act as opposed to the more general requirement in the Canadian legislation for provincial consultation and reasonable efforts to secure action by the provincial government. In my judgment, that difference does not significantly restrict the ability of the Government of Canada to provide essentially the same rights to the United States. The Canadian requirement for federal consultation and efforts to procure provincial action fills the same role as the State plan revision process in the U.S. system. Consequently, I have concluded that, despite the differing process at the State and provincial levels, the Canadian legislation does provide the Government of Canada with ample authority to give essentially the same rights to the United States as are provided by Section 115.

I should observe that the provisions of the Canadian legislation do appear to provide the Minister of Environment with some discretion regarding the scope of the remedy he must recommend, as well as the adequacy of any remedies undertaken by the provincial government. Similarly, the Governor Council is apparently provided with discretion regarding final prescription of specific emission standards as is the case for all regulations issued under the Canadian Clean Air Act. For these reasons, my determination that the Canadian legislation provides essentially the same rights as Section 115 could be changed should the United States conclude that future Canadian actions interpreting or implementing their legislation were not giving essentially the same rights to the United States.

As you know, Section 115 is activated by giving formal notification to the Governor of a specific State. EPA has not yet determined which State or States will require notification under Section 115. I have instructed my staff to examine this issue and to develop recommendations regarding the States which should receive formal notification. Notification to a State under the Clean Air Act is only the first of several steps in the plan revision process. After receiving a plan revision notification, the State must identify and propose control measures to address the problem and provide opportunity for public hearing prior to adoption and submittal to EPA.

Several factors will require that EPA make extraordinary efforts to consult and cooperate with affected States in this process. The acid deposition problem is clearly a regional one which crosses numerous State boundaries. The affected States will need to discuss the problem with one another and EPA will need to assist them in this effort. Second, since there are no established numerical standards by which to assess the adequacy of acid deposition mitigation measures, EPA and the affected States will have to work closely on developing target levels for State and regional emission reductions.

In summary, I believe the IJC Report confirms that acid deposition is endangering public welfare in the United States and Canada and that U.S. and Canadian sources contribute to the problem not only in the country where they are located but also in the neighboring country. Regarding the requirement of reciprocol rights, I believe the new Canadian legislation provides the Government of Canada with ample authority to give the United States essentially the same rights as Section 115. While this conclusion is adequate to warrant the initiation of a Section 115 based plan revision process in appropriate States, I must emphasize that during such a process and at the time of any final action, the Administrator must continue to be able to find that Canada is giving the United States essentially the same rights based on an evaluation of Canada's interpretation and implementation of its legislation.

I appreciate your interest in this very important subject. EPA will continue to keep your office informed of its actions on this matter.

Sincerely yours,

Douglas Costle.

Exhibit 3

Center for Law and Social Policy,
Washington, D.C., February 26, 1981.

Mr. James L. Buckley,
Under Secretary of State for Security Assistance, Science and Technology, Department of State, Washington, D.C.

Dear Mr. Buckley: The undersigned organizations have been very concerned about the problem of acid rain, particularly in the Northeastern U.S. and Canada, and how the U.S. is moving to address it. We have written to your office on several occasions over the last year. We write at this time to express our continuing interest and concern with acid rain as both a national and international problem.

Under the Memorandum of Intent with Canada which was signed August 5, 1980 we are required to take certain "interim actions" to combat the acid rain problem. Those actions are to include "vigorous enforcement of existing domestic legislation." Yet little action to actually reduce the emissions which cause acid rain is evident. Moreover, the public is largely being excluded from the policy development process regarding strategies to deal with acid rain.

The serious environmental impacts and risks of acid rain have been amply documented over the past several years. Most recently the Seventh Annual Report of Great Lakes Water Quality submitted by the International Joint Commission in October, 1980, and the Second Report of the U.S.-Canada Research Consultation Group on Long-Range Transboundary Air Pollution, released in November 1980, both reiterate the gist of previous findings: destruction by acid rain of lake and stream ecosystems, which impedes fish spawning and renders the waters uninhabitable by fish; increasing numbers of "dead lakes" in Northeastern U.S. and Canada; damage to soils, crops and forests; potential contamination of drinking water supplies through the leaching of certain heavy metals. In addition, the Phase I Interim Report on Strategies Development and Implementation of the Working Groups involved in the preliminary work for the upcoming Transboundary Air Quality Treaty negotiations states unequivocally that "pollutants, particularly acid precursors, are known to travel for distances of up to thousands of miles through the atmosphere, and thus, in North America, they frequently cross political boundaries." These recent reports emphasize that the acid rain problem is a serious and continuing one and indicate the necessity for immediate and remedial efforts.

We understand that negotiations for the Transboundary Air Quality Treaty are scheduled to begin in June 1981. We have been concerned at the secrecy that has surrounded the activity of the working groups and the lack of public participation in the whole process generally. We have requested repeatedly that the public be given an active role in the negotiating process and believe that we had been given certain assurances in that regard. Recently, however, we have been informed that some government officials believe there are "legal problems" regarding public representation on the negotiating teams. Instead, a series of "public hearings" apparently has been planned to provide some public input. While we think such hearings may be helpful, we do not believe they will effectively provide the input necessary nor ensure that the interests of the various public sectors affected, including environmental, health, tourist, forestry and fishing interests, will be protected. What is required is public representation and direct involvement in the negotiating process by informed public representatives. We also believe some form of public advisory committee should be constituted on acid rain to review proposed government positions and to provide the perspective of various public interests.

Although we have written to your office and to the Environmental Protection Agency several times in the past year, we have never received substantive responses to our suggestions. We would like to reiterate some of those earlier suggestions:

1. Under § 123 of the Clean Air Act, the use of tall stacks to disperse SO_2 high into the atmosphere was to be used only when necessary to limit excessive ground concentrations. EPA has been willing to allow the use of tall stacks even in the absence of any showing of necessity. Dispersing SO_2 higher into the atmosphere increases the distance it travels and thereby spreads the acid rain deposition over a wider area. EPA should tighten its tall stacks policy to permit their use, if at all, only where there is a clear, demonstrated necessity.
2. EPA should not relax any SO_2 limits on utilities emissions.
3. EPA could require the washing of all coal used in utilities in the affected areas as a mandatory control technique, with no banking of credit allowed under the Clean Air Act trade-off policy for consequent reductions in emissions in the U.S.
4. Best available control technology should be required of all new plants in any area likely to be a potential source of transboundary air pollution, including controls on NO_x.
5. Section 115 of the Clean Air Act should be used to require revision of State implementation plans in states contributing to the transboundary acid precipitation problem. The new SIPs should require much stricter control of SO_2 and NO_x emissions. Whatever problems were thought to exist several months ago on the question of use of § 115 have been solved with the recent amendment of the Canadian Clean Air Act. It now includes a section much like our § 115, providing ample "reciprocity" for the U.S. under Canadian law. In fact that amendment was made by the Canadian government specifically to provide the requisite reciprocity so that we would be able to implement § 115.

We were pleased to see in EPA's response to Senator Mitchell's letters to Douglas Costle requesting § 115 action that the government has made the determination that the prerequisites to § 115 action have been met. It is now

EPA's nondiscretionary duty to proceed under § 115. We would urge you to not only take that step, but also ask that you work to ensure that the public will be represented at the upcoming negotiations on the Transboundary Air Quality Treaty with Canada.

Best regards.

Sincerely yours,

JAMES N. BARNES,
DENISE YARBROUGH.[1]

On behalf of: Adirondack Council; Coalition for the Environment; Environmental Action; Environmental Defense Fund; Friends of the Earth; Friends of the Boundary Waters Wilderness; GASP; Great Lakes Tomorrow; National Aubudon Society; National Coalition for Clean Air; National Parks and Conservation Association; National Wildlife Federation; NaturaljResources Defense Council; Northern Plains Resources Council; Ohio Environmental Council; Sierra Club; and Wilderness Society.

EXHIBIT 4

DEPARTMENT OF STATE,
UNDER SECRETARY OF STATE,
SECURITY ASSISTANCE, SCIENCE AND TECHNOLOGY,
Washington, D.C., May 18, 1981.

Mr. JAMES N. BARNES,
Center for Law and Social Policy,
Washington, D.C.

DEAR MR. BARNES: I regret the delay in responding to your letter of February 26, 1981 in which you expressed continuing concern over the problem of acid rain, particularly in the northeastern U.S. and Canada, on behalf of a number of environmental organizations.

What is known about the acid rain problem does indicate that it is genuine and serious. Research is continuing under the Memorandum of Intent on Transboundary Air Pollution with Canada to develop a clearer understanding of acid rain and other air pollution problems.

In the area of interim actions, the U.S. Government is undertaking a number of steps. The Department of Energy is preparing a regional environmental impact statement to address the cumulative impacts of multiple coal conversions in the northeastern U.S. The air quality effects of these conversions on Canada will be included. The draft EIS is expected in June and will be made available to Canada. Comments from the Canadian federal, provincial and local governments, as well as Canadian private citizens, will be welcome.

The Department of Energy and the Environmental Protection Agency are developing new technologies for pollution control and new low pollution processes, such as fluidized bed combustion. Under study is the limestone injection multi-stage burner (LIMB) process, a fairly low-cost retrofit SO_2/NO_x control technology. Information on these developments is being shared with Canada. You may wish to be in touch directly with the Department of Energy and the Environmental Protection Agency regarding other interim actions.

The question of public participation in the process of preparations for negotiations with Canada has been given considerable attention within the federal government. We have been considering whether to form an advisory committee, at an appropriate time in the discussions. We have also considered the availability of and the utility of such a step. In addition, we have given consideration to a program of public contacts and briefings.

I enclose for your information a copy of the interim report of the Work Group on Strategies Development and Implementation, together with information on how to obtain other recently published reports in connection with this issue. We would be pleased to have your comments on the reports.

We have noted your comments on matters before the Environmental Protection Agency and that you have written EPA Administrator Gorsuch directly.

Sincerely yours,

JAMES L. BUCKLEY.

Enclosures as stated.

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[1] Law student intern.

Exhibit 5

POSITION STATEMENT ON ACID DEPOSITION

The primary cause of acid precipitation in the eastern United States is believed to be man-made emissions of acid-forming materials. These materials—sulfur dioxide from burning sulfur-containing fuels, and nitrogen oxides from industrial and utility boilers and vehicular exhaust—can be chemically transformed in the atmosphere into acidic compounds. Acid precipitation precursors are carried by winds, often across great distances, before returning to Earth as rain or snow or being deposited in dry form.

Mounting evidence indicates that acid deposition can stress or kill aquatic species in waters unable to neutralize or "buffer" its acidity (as encountered, among other places, in the Adirondack and Appalachian regions, much of New England, Michigan, Wisconsin. Minnesota, and Oregon, and in parts of California and Colorado). In addition, acid precipitation mobilize soil ions, leading to irreversible losses of soil nutrients and harmful conditions for soil and aquatic organisms. Acid deposition also destroys man-made materials and natural structures. For example, it accelerates metal corrosion, while exposure to sulfur compounds in the air causes blistering and scaling of painted and other treated surfaces and loss of surface cohesion of limestone and sandstone. The erosion of statues and stone structures by acid precipitation is well-documented.

Accordingly, although gaps remain in our complete understanding of acid deposition processes, and more research is needed to fill these voids, we, the undersigned scientists believe that what is already known about this phenomenon amply justifies and requires immediate legislative steps to begin abating emissions of human-generated acid rain precursors.

Signature ____________________ Date ____________

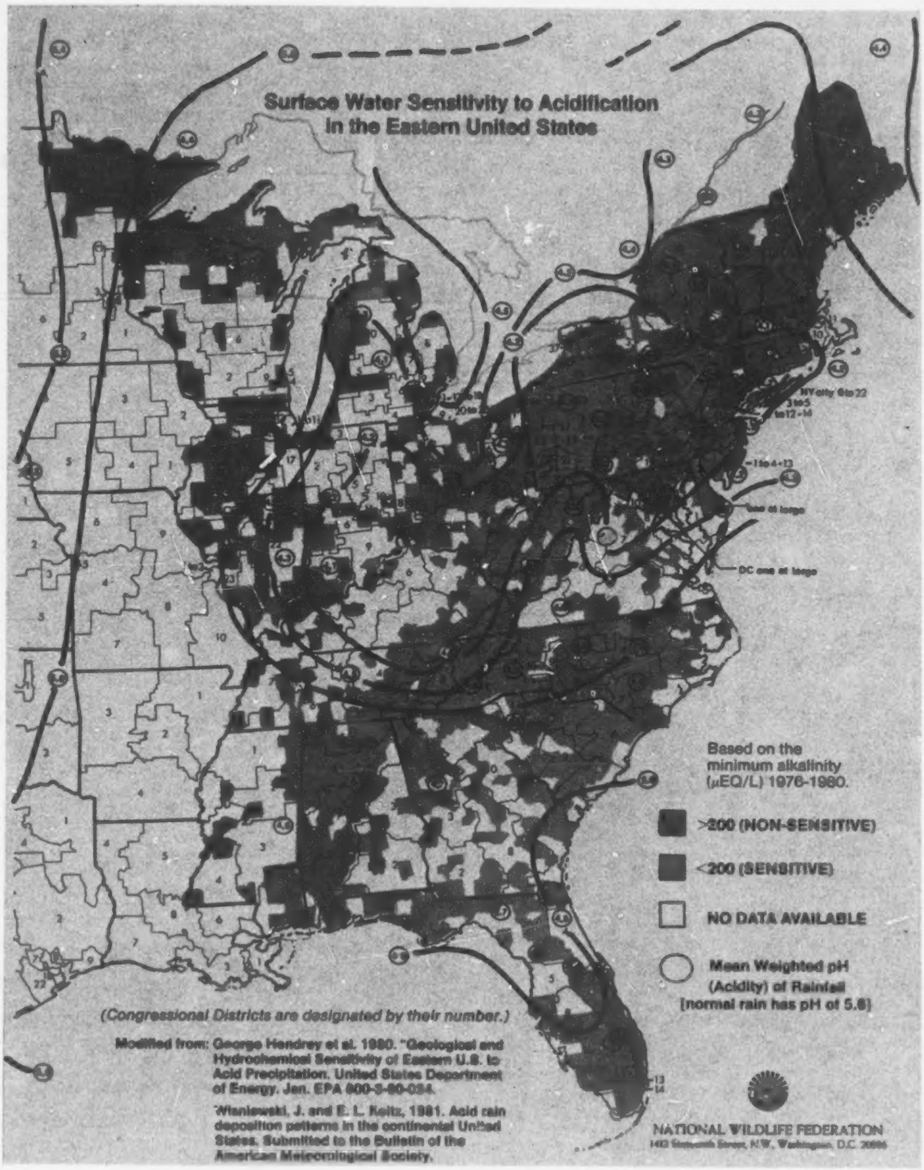
Name ____________________

(Area Code :) ____________________ Telephone No. ____________

LIST OF SCIENTISTS WHO HAVE SIGNED THE NWF ACID DEPOSITION STATEMENT

1. Dr. John M. Melack, Department of Biological Sciences, University of California.
2. C. Ray Thompson, University of California, Statewide Air Pollution Research Center.
3. Dr. John E. Heasley, Systems Ecologist, Natural Resources Ecology Lab, Colorado State University.
4. Thomas W. Lester, Kansas State University.
5. Dr. G. Richard Marzolf, Division of Biology, Kansas State University.
6. Hugh T. Spencer, Sc. D., Chemical and Environmental Engineering, University of Louisville, Louisville, Ky.
7. Robert D. Conkwright, Maryland Geological Survey, Johns Hopkins University, Baltimore, Md.
8. James M. Hill, Mid-Atlantic Acid Rain Survey.
9. Arthur Kingle, Jr., Mid-Atlantic Acid Rain Survey.
10. James Burtis, Jr., Mid-Atlantic Acid Rain Survey.
11. Fred Davis, Mid-Atlantic Acid Rain Survey.
12. John F. Kundt, Mid-Atlantic Acid Rain Survey.
13. Steven Paul Aust, Mid-Atlantic Acid Rain Survey.
14. Maria-Victoria Chattey, Mid-Atlantic Acid Rain Survey.
15. Robert H. Beman, Mid-Atlantic Acid Rain Survey.
16. Alfred M. Beeton, Ann Arbor, Mich.
17. Paul O. Fromm, Department of Physiology, Michigan State University.
18. Dr. Nathan M. Reiss, Department of Meteorology and Physical Oceanography, Cook College, Rutgers, N.J.
19. Dr. Gerald E. Streit, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
20. Dr. Carl Schofield, Department of Natural Resources, Cornell University, New York, N.Y.

21. Dr. G. R. Hendrey, Brookhaven National Laboratory, Upton, Long Island, N.Y.
22. Paul C. Katen, Ph. D., Oregon State University, Department of Atmospheric Sciences.
23. Richard W. Boubel, Ph. D., Department of Atmospheric Sciences, Oregon State University.
24. John McBain Hubbe, Department of Atmospheric Sciences, Oregon State University.
25. Dr. Raymond C. Mathews, Uplands Field Research Laboratory, Gatlinburg, Tenn.
26. D. W. Holy, Environmental Engineering Division, TRW, Dallas, Tex.
27. Ronald D. Mathews, University of Texas at Austin, Austin, Tex.
28. John M. Skelly, Department of Plant Pathology and Physiology, Virginia Polytechnic Institute, Blacksburg, Va.
29. Richard Klein, The University of Vermont, Department of Botany, Burlington, Vt.
30. H. W. Vogelmann, The University of Vermont, Department of Botany, Burlington, Vt.
31. Anthony C. Tomkowski, A.C., Division of Forestry, West Virginia University.
32. James Galloway, Department of Environmental Sciences, Clark Hall, University of Virginia, Charlottesville, Va.
33. Dr. John J. Hassett, Professor Soil Chemistry, University of Illinois at Urbana.
34. Professor E. R. Altwicker, Ph. D., Rensselaer Polytechnic Institute, Troy, N.Y.
35. D. R. Jackson, Battelle, Columbus Laboratories, Columbus, Ohio.
36. Patrick R. Dugan, Ohio State University, College of Biological Sciences.
37. Meredith B. Colket III, Research Scientist, United Technologies Research Center.
38. Martin F. Zabielski, Ph. D., Manchester, Conn.



Surface Water Sensitivity to Acidification in the Eastern United States

Based on the minimum alkalinity (μEQ/L) 1976-1980.

▇ >200 (NON-SENSITIVE)

▇ <200 (SENSITIVE)

☐ NO DATA AVAILABLE

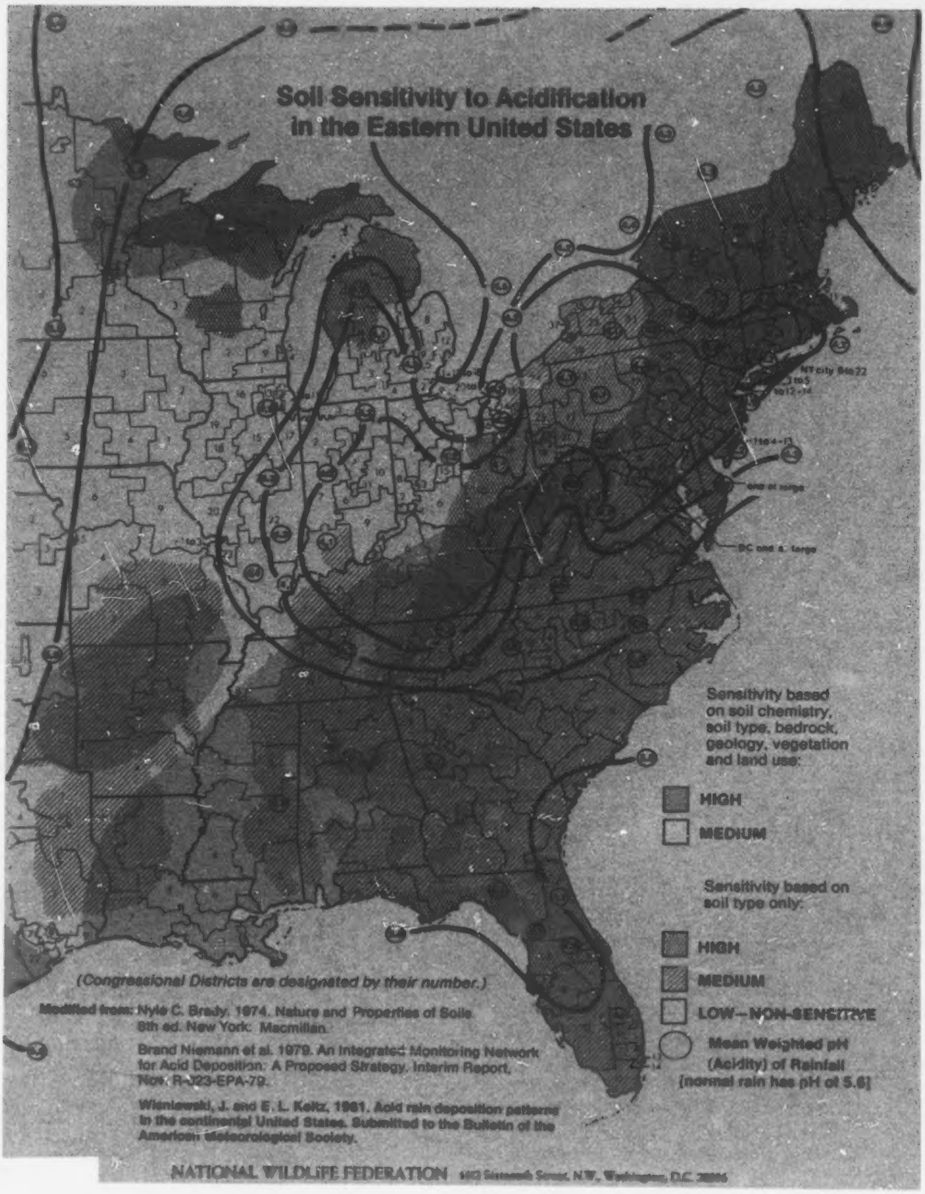
○ Mean Weighted pH (Acidity) of Rainfall [normal rain has pH of 5.6]

(Congressional Districts are designated by their number.)

Modified from: George Hendrey et al. 1980. "Geological and Hydrochemical Sensitivity of Eastern U.S. to Acid Precipitation. United States Department of Energy. Jan. EPA 600-3-80-024.

Wisniewski, J. and E. L. Keitz, 1981. Acid rain deposition patterns in the continental United States. Submitted to the Bulletin of the American Meteorological Society.

NATIONAL WILDLIFE FEDERATION
1412 Sixteenth Street, N.W., Washington, D.C. 20036



Soil Sensitivity to Acidification in the Eastern United States

Sensitivity based on soil chemistry, soil type, bedrock, geology, vegetation and land use:
HIGH
MEDIUM
Sensitivity based on soil type only:
HIGH
MEDIUM
LOW—NON-SENSITIVE
Mean Weighted pH (Acidity) of Rainfall [normal rain has pH of 5.6]
NY city 8 to 22
DC and s. large

(Congressional Districts are designated by their number.)

Modified from: Nyle C. Brady. 1974. Nature and Properties of Soils 8th ed. New York: Macmillan.

Brand Niemann et al. 1979. An Integrated Monitoring Network for Acid Deposition: A Proposed Strategy. Interim Report. Nov. R-023-EPA-79.

Wisniewski, J. and E. L. Keitz, 1981. Acid rain deposition patterns in the continental United States. Submitted to the Bulletin of the American Meteorological Society.

NATIONAL WILDLIFE FEDERATION 1412 Sixteenth Street, N.W., Washington, D.C. 20036

Exhibit 8

Acid Rain Damage Scarring the East

Mr. Moffett. Mr. Speaker, the National Wildlife Federation has provided an excellent analysis of the damage afflicting the 27 States east of the Mississippi due to acid rain. I am providing this material to the Members and I am urging them to support my legislation, H.R. 4829, for the control of acid rain:

ACID RAIN VULNERABILITY OF THE 27 STATES EAST OF THE MISSISSIPPI—A SUMMARY

A National Wildlife Federation (NWF) report on the "Acid Rain Vulnerability of the 27 states East of the Mississippi River" determined that 15 of the 27 states are "extremely vulnerable" to the adverse impacts of acid rain, while 10 states are "moderately vulnerable". One state—Florida—demonstrated "low vulnerability" on a statewide basis (although displaying moderate to high sensitivity and scattered areas of sensitive surface waters). One State, Louisiana, could not be evaluated because of insufficient data.

Using data from published acid rain studies, precipitation chemistry monitoring stations and personal communications with scientific experts, NWF qualitatively assessed the overall acid rain vulnerability of the Eastern U.S. This evaluation limited to the 27 states East of the Mississippi River where the most complete information is available.

The 27 states have been individually ranked in a table according to their vulnerability to fishery, soil, crop foliage and masonry damage. Visibility impairment and automobile paint damage—measures of existing rather than potential impact—were also considered. A ranking of extreme (E), moderate (M) or low (L) vulnerability was assigned to each state based on factors specific to that state. The summary table in the NWF report also provides a relative ranking of the states determined by the sum of their acid rain sensitivities for each category.

Acid rain vulnerabilities were assessed by examining multiple interactive factors. In evaluating the sensitivity of fisheries in each of the 27 states, for example, NWF considered studies which examined surface water alkalinity and bedrock geology (which are indicators of the ability of water to buffer acidic inputs), soil type and soil chemistry (which are indicators of the resiliency of the soil to buffer acidic inputs and the associated leaching of toxic metals) and a mean weighted pH acidity of rain. Although the most publicized acid rain-impacted fisheries are those in the Adirondack region of upstate New York, NWF found that 13 states have extremely vulnerable fisheries while 8 states' fisheries are moderately vulnerable to acid rain effects. Many of the same factors—soil chemistry, soil type, bedrock geology and average weighted pH of rainfall—were used to determine each state's sensitivity to soil acidification. These factors, when considered in combination, reveal that 13 states have soils which are extremely vulnerable to acid rain with 12 states prossessing moderately vulnerable soils.

The rankings for crop foliage damage were based on studies which have documented the pH at which foliage damage to specific crops occurs as well as on the occurrence of high acidity rainfalls within each state. Similiarly, damage to masonry materials was estimated by applying a rough pH range of stone sensitivity to mean weighted annual pH data for the 27 states. It was found that 23 states were vulnerable to masonry damage.

NWF based the estimates of automobile paint damage in each state on actual reports of automobile paint damage and on sulfate/acid rain concentrations occurring in each state. It was found that Florida, New Jersey, New York and Pennsylvania had the highest incidence of reported automobile paint damage due to acid rain last year.

NWF's visibility impairment ratings were determined from studies which assessed the yearly average sulfate concentration found in the U.S. during the mid 1970's and on NO_x concentrations found in the early 1970's. Based on these studies, it was estimated that 20 states had high visibility impairment, while 5 states had a moderate degree of impairment.

This analysis demonstrates the pervasiveness and potential severity of the acid rain problem in the Eastern U.S. and strongly refutes the contention that acid rain is a problem of limited geographic scope. Even some western states are currently experiencing the impacts of acid rain.

Based on the conclusions of this report and its review of the most current acid rain studies, it is apparent that immediate legislative action is needed to begin reducing the emissions of acid rain precursors—especially sulfur dioxide from major coal-fired electric generating stations—in the Eastern United States. This problem must be addressed with a sense of urgency before a growing catalogue of "vulnerable" states succumbs to what may be irreversible acid rain damage.

EVALUATION OF EASTERN STATES VULNERABILITY TO EFFECTS OF ACID RAIN

State	pH range of rainfall	Average pH of rainfall	Fisheries	Soil	Crop foliage	Masonry (marble, limestone)	Overall ranking	Visibility impairment	Automobile paint damage
Alabama	3.7	4.6	M	M	V	M	M	E	S
Connecticut	3.6	4.4	E	E	V	M	E	E	S
Delaware	3.5 to 5.0	4.4	M	M	V	M	M	E	M
Florida	4.2 to 6.1	4.7	S	S	NV	S	S	M	E
Georgia	4.1 to 6.3	4.6	M	M	NV	S	M	M	S
Illinois	3.8 to 6.7	4.3	S	S	V	M	M	E	M
Indiana	3.8	4.3	S	M	V	M	M	E	M
Kentucky	3.7	4.4	M	E	V	M	E	E	M
Louisiana	XX	4.6	XX	M	XX	S	XX	E	S
Maine	3.4 to 6.9	4.4	E	E	V	M	E	S	S
Maryland	3.7	4.3	M	M	V	M	M	E	S
Massachusetts	3.5 to 5.7	4.1	E	E	V	M	E	E	M
Michigan	3.8 to 6.1	4.4	E	E	V	M	E	E	M
Mississippi	4.2 to 5.3	4.6	M	M	NV	S	M	E	S
New Hampshire	3.7 to 6.2	4.3	E	E	V	M	E	S	M
New Jersey	3.5 to	4.3	E	M	V	M	E	E	E
New York	3.4 to 5.1	4.2	E	E	V	M	E	E	E
North Carolina	3.3 to 6.9	4.4	E	E	V	M	E	M	M
Ohio	3.6 to 5.1	4.2	S	M	V	M	M	E	M
Pennsylvania	3.5 to 5.9	4.2	E	E	V	M	E	E	E
Rhode Island	3.5 to	4.4	E	E	V	M	E	E	M
South Carolina	3.2 to 4.7	4.6	E	M	V	M	E	M	S
Tennessee	3.5	4.4	M	M	V	M	M	E	S
Vermont	3.5	4.3	E	E	V	M	E	M	M
Virginia	3.1 to 5.1	4.4	M	M	V	M	M	E	M
West Virginia	3.8 to 6.3	4.3	M	E	V	M	E	E	M
Wisconsin	3.8 to 6.1	4.5	E	E	V	M	E	E	M

E—Extremely vulnerable to acid rain effects. M—Moderately vulnerable in acid rain effects. S—Slightly vulnerable to acid rain effects. V—Vulnerable to acid rain effects. NV—Not vulnerable to acid rain effects. XX—Insufficient data.

EXHIBIT 9

NATIONAL WILDLIFE FEDERATION,
Washington, D.C., February 8, 1982.

MEMORANDUM

To: Interested Parties.
From: The National Wildlife Federation.
Subject: Costs of Reducing Electric Utility Sulfur Dioxide Emissions to Control Acid Rain.

The attached tables and Inside EPA summary provide highlights of the ICF report, Cost and Coal Production Effects of Reducing Electric Utility Sulfur Dioxide Emissions (Nov. 14, 1981). This report analyzes the economic implications of Federal legislative proposals to reduce sulfur dioxide emissions by 10 million tons per year over the next decade.

The ICF analysis projects that ten million ton reduction accomplished by 1990 would result in an average increase in eastern utility rates of only 1.9 percent in 1990, at an overall annualized cost of $2.4 billion. In the year 2000, eastern electricity rates would be 1.3 percent higher due to the program and annualized costs would be $3.4 billion. State rate increases under a program that would require reduction equivalent to controlling high-emitting plants to a level of 1.2 pounds of sulfur dioxide per million Btu's range from 0.5 percent rate reduction in the mid-Atlantic region to a 4.7 percent rate increase in the Ohio River Valley (East North Central region). The largest state rate changes that would occur under this formula would be from 6.6 percent to 7.4 percent increases in Ohio, Indiana, and Missouri. These states with the largest rate increases are among today's largest emitters. In 1990, even after these rate increases, these states would still enjoy rates less than those in the mid-Atlantic and New England states.

For further information, please contact: Ken Kamlet, 797-2945; Steve Howards, 797-6891.

Attachments.

ICF STUDY SHOWS ACID-RAIN REDUCTION PROPOSAL IS AFFORDABLE, NCAC/NWF SAY

An ICF analysis of impacts of an acid-rain mitigation strategy hooked to a targeted 10-million-ton reduction in sulfur emissions, prepared for the National Clean Air Coalition and National Wildlife Federation, has concluded that:

> The annualized cost of reduction would be $2.4-billion in 1990 and $3.4 billion in 2000, an "affordable" target, NCAC/NWF say, since acid rain damage is costing "at least $5-billion annually in the Northeast alone."
>
> Electric rates in a 31-state region that would be involved in an acid-rain strategy (the states identified in both Senate and House proposals) would increase 1.9 percent in 1990, then drop after that, a "minimal" increase, the environmental groups say.
>
> Substantial shifts to low-sulfur coal will occur, increasing production in central Appalachia and the West with concomitant declines in other parts of Appalachia and the Midwest. But NCAC/NWF say "this acid rain control program will not have any consequential effect on the volume of coal sales nationally" and overall production in all but a few states will increase from today's production levels.

The ICF analysis draws on previous work it conducted for EPA and the Dept. of Energy, but—as commissioned by the environmental groups—relates its data to a 10-million-ton/year sulfur emissions reduction based on a least-cost emission trading strategy, the underpinning approach of S. 1706, introduced by George Mitchell (D-ME), and H.R. 4829, introduced by Toby Moffett (D-MA) and Judd Gregg (R-NH). The bills define a 31-state region bordering on or east of the Mississippi subject to controls, then apportion a share of a 10-million-ton reduction target in 10 years, based on each state's relative percentage contribution to current emission levels, totaling 18-million tons in the 31-state region. The environmental groups are supporting the approach, but they say the 10-million-ton reduction probably "is less than what we will need ultimately."

The ICF analysis says that about 8.5-million tons of a 10-million-ton 1990 reduction based on least-cost emissions would come from 10 of the 31 states: Illinois, Indiana, Kentucky, Michigan, Missouri, Ohio, Pennsylvania, Tennessee, West Virginia, and Wisconsin. The ICF report to NCAC/NWF cites a number of caveats, including that the analysis covers removing 10-million tons of utility emissions and it may be more cost-effective to include in the strategy as much as 500,000 tons of non-utility industrial SO_2 emission reductions; natural gas regulatory policies can have a major impact on the costs of acid rain mitigation, as can new technologies; and the analysis doesn't evaluate the administrative and political feasibility of intrastate and interstate emission rights trading.

Power rates.—NCAC/NWF say that a 10-million-ton reduction by 1990 would produce only a "minimal" 1.9 percent average increase in rates, although Ohio River Valley states (Ohio, Michigan, Indiana, Illinois, Wisconsin) would increase 4.7 percent and individual states would experience significantly higher increases—Ohio, 6.6 percent; Indiana, 7.4 percent; Missouri, 7 percent. "The states with the largest rate increases are among today's largest emitters. In 1990, even after these rate increases, these states would still enjoy rates substantially less than those in the Mid-Atlantic and New England states." Mid-Atlantic states (New York, New Jersey, Pennsylvania), the ICF analysis indicates, would drop 0.5 percent and rates in New England states would increase only 0.5 percent.

Coal supply.—The environmental groups say in a statement accompanying the ICF analysis of impacts that coal production "in all but a few states, given the growth projections used by ICF and many government agencies, will continue to increase from today's production levels to 1990 and all states to the year 2000." Three states (Pennsylvania, Ohio, and Illinois), according to the projections, actually dip markedly (as much as 22 percent) by 1990 compared to 1979 levels, but projected out to the year 2000 they all gain in amounts up to 140 percent over 1979 levels. The biggest gains in coal consumption are low-sulfur production areas—southern West Virginia, projected to increase 108 percent in 1990 compared to 1979, and the Powder River areas of Montana and Wyoming, up 62-82 percent.

The 10-million-ton target.—The target reduction amounts to 43 percent reduction in eastern sulfur-dioxide emissions or 34-38 percent of combined sulfur and nitrogen emissions—less than the 50 percent reduction that the National Academy of Science suggested would be needed to protect "the most seriously affected areas," the NCAC/NWF paper says, While 10-million is "less than what we will need ultimately," the groups say, "lesser reductions will do little to reduce damage that is already occurring and will allow more damages to accumulate."

COMPARATIVE ELECTRICITY RATES; 2000

[Mid-1980 dollars]

Region	Base electricity rate (mills per kilowatt-hour)[1]	Percent change in rates 1.2 lb 30-day average[1 2]	Comparative resulting rates (mills per kilowatt-hour)[3]
New England:			
Maine/Vermont/New Hampshire		0.7	90.50
Massachusetts/Connecticut/Rhode Island		.3	90.15
Total[4]	89.88	.4	90.24
Middle Atlantic:			
New York, Upstate		1.4	84.37
Pennsylvania, East/New Jersey/New York, downstate		.5	83.45
Pennsylvania, West		3.2	85.70
Total[4]	83.04	1.6	84.36
South Atlantic:			
Virginia/Maryland/Delaware		.7	75.02
West Virginia		2.7	76.51
North and South Carolina		.5	74.87
Georgia		1.7	75.77
Florida		.7	75.02
Total[4]	74.50	1.0	75.24
East North Central:			
Ohio		6.2	62.53
Michigan		1.7	59.88
Indiana		5.4	62.06
Illinois		.7	59.29
Wisconsin		4.7	61.65
Total[4]	58.88	3.6	60.99
East South Central:			
Kentucky		4.7	61.33
Tennessee		2.7	60.16
Alabama		1.6	59.52
Mississippi		(1.3)	57.82
Total[4]	58.88	2.4	59.98
West Bank Mississippi:			
Minnesota		(.1)	73.39
Iowa		(.1)	73.40
Missouri		6.0	77.88
Arkansas		.2	73.62
Louisiana		.1	73.54
Total[4]	73.47	1.2	74.35
Total United States[4]	67.90	1.3	68.78

[1] Figures taken from ICF table 10-B.

[2] Actual standard is approximately 1.076 lb—annual average.

[3] Figures computed by the National Clean Air Coalition from ICF table 10-B.

[4] Totals do not add due to weighted averaging.

COMPARATIVE ELECTRICITY RATES; 1990

[Mid-1980 dollars]

Region	Base electricity rate (mills per kilowatt hour)[1]	Percent change in rates 1.2 lb 30-day average[1][2]	Comparative resulting rates (mills per kilowatt hour)[3]
New England:			
Maine/Vermont/New Hampshire		0.7	74.25
Massachusetts/Connecticut/Rhode Island		.4	74.02
Total[4]	73.73	.5	74.09
Middle Atlantic:			
New York, Upstate		1.4	69.07
Pennsylvania, East/New Jersey, New York, Downstate		(4.7)	64.92
Pennsylvania, West		3.1	75.23
Total[4]	61.12	(.5)	67.77
South Atlantic:			
Virginia/Maryland/Delaware		.9	61.67
West Virginia		2.1	62.40
North and South Carolina		.6	61.49
Georgia		4.1	63.62
Florida		.7	61.55
Total[4]	61.12	1.4	61.97
East North Central:			
Ohio		6.6	51.49
Michigan		2.4	49.46
Indiana		7.4	51.87
Illinois		2.8	49.65
Wisconsin		5.6	51.00
Total[4]	48.30	4.7	50.57
East South Central:			
Kentucky		5.8	50.85
Tennessee		4.1	50.03
Alabama		2.4	49.21
Mississippi		.4	48.25
Total[4]	48.06	3.6	49.79
West Bank Mississippi:			
Minnesota		.5	56.57
Iowa		1.5	57.13
Missouri		7.0	60.23
Arkansas		(.4)	56.06
Louisiana		0	56.29
Total[4]	56.29	2.2	57.53
Total United States[4]	55.77	1.4	56.55

[1] Figures taken from ICF table 10-B.
[2] Actual standard is approximately 1.076 lb—annual average.
[3] Figures computed by the National Clean Air Coalition from ICF table 10-B.
[4] Totals do not add due to weighted averaging.

Senator PRESSLER. Thank you very much. I checked, and I am a dues-paying member of the Wilderness Society—although I think your group does a lot of good work, too. I am also a member, a long-time member, of the Izaak Walton League at Madison, S. Dak.

Mr. KAMLET. I will be glad to send you a subscription form.

Senator PRESSLER. I am going broke. You see, we do not give ourselves pay raises and it is tough to pay all those dues.

Next, I call on Robert E. Stein, president of the Environmental Mediation International, Washington, D.C.

[Mr. Stein's biographical data follows:]

BIOGRAPHICAL DATA OF ROBERT E. STEIN

Name: Robert E. Stein.

Address: Office: Suite 310, 1015 Eighteenth Street NW., Washington, D.C. 20036 (202) 457-0457. Home: 4945 Brandywine Street NW., Washington, D.C. 20016 (202) 244-3204.

Personal data: Born February 12, 1939, New York City. Married. Member of New York and District of Columbia Bars.

Professional experience: President, Environmental Mediation International, Inc. (October 1978–Present). Non-profit organization concerned with the uses of mediation to resolve international environmental disputes.

Attorney-At-Law. Washington, D.C. (October 1964-Present) Presently serves as Special Counsel, OECD, Environment Directorate. Member, Advisory Committee on Tropical Diseases, Edna McConnel Clark Foundation. Arbitrator and Mediator.

Secretary and Director of North American Office, International Institute for Environment and Development (July 1974–September 1978). Directed and participated in projects on marine environment, environmental assessment, ocean energy and health. Served on NAE Panel on Ocean Energy. Served as adviser to U.S. Delegation to the United Nations Water Conference.

Senior Research Manager, The American Society of International Law (December 1974–September 1976). Acting Director of Studies (July 1973–December 1974). Coordinated and participated in Society research projects, including those concerned with international environment, communications, energy, and the Law of the Sea.

Consultant (October 1972–1976). International and Domestic Environmental Problems, Legal, Policy, and Institutional Aspects. Clients included the O.A.S., O.E.C.D., Congressional Research Service of the Library of Congress, U.N. Environment Programme.

Fellow, Woodrow Wilson International Center for Scholars (October 1970–October 1972). Projects on institutional and legal aspects of environmental problems; adjustment of international environmental disputes.

Attorney-Adviser (International) Office of the Legal Adviser, Department of State (March 1969–October 1972). Environmental, Atomic Energy, European, and East Asian matters. Counsel, International Joint Commission (U.S.-Canada).

Attorney-Adviser (International), U.S. Arms Control and Disarmament Agency (September 1966–March 1969). Legal Adviser, U.S. Delegation, Geneva Disarmament talks (July–December 1967).

The Editorial Reviser for the American Law Institute's Restatement, Foreign Relations Law of the United States (July 1964–September 1965).

Research Assistant to Wolfgang Friedmann, Professor, International Law, Columbia Law School (October 1962–June 1964).

Teaching experience: Adjunct Professor of Environmental Law, American University Law School (1972–Present); Georgetown Law Center (1971–1972).

Education: Hague Academy of International Law, Diploma (1964). Columbia University School of Law, LL.B (June 1963), Editor, Columbia Journal of Transnational Law. Brandeis University, B.A. (June 1960).

Selected publications: "The Use of Section 115 of the Clean Air Act to Control Long Range Transport of Air Pollution Between the United States and Canada." Report for Environment Canada and EPA (February 1981).

Banking on the Biosphere (with Brian Johnson), (Lexington Press, January 1979).

Critical Environmental Issues on the Law of the Sea, (Ed. IIED, 1975). Legal and Political Aspects of OTEC, Ed. (Lexington Press, 1977). International Responsibility for Environmental Harm, Ed. (In press) The Adjustment and Avoidance of Environmental Disputes, Ed. (In press)

Responsibility and Liability for Harm to the Marine Environment, (Georgia Journal of International and Comparative Law, 1976). The Potential of Regional Organizations in Managing the Human Environment, (1972).

Beyond the U.N Water Conference (Natural Resources Forum, 1978).

Professional associations: Member, American Society of International Law (Board of Advisers, International Legal Materials); American Bar Association; American Society of Tropical Medicine and Hygiene; of Arbitrators, American Arbitration Association.

STATEMENT OF ROBERT E. STEIN, PRESIDENT, ENVIRONMENTAL MEDIATION INTERNATIONAL, WASHINGTON, D.C.

Mr. STEIN. Thank you, Mr. Chairman. I, too, would like to summarize my statement and ask that the complete statement be submitted for the record.

Environmental Mediation International, the organization of which I am president, is incorporated both in Washington, D.C. and in Ontario, Canada, and set up to examine the ways in which mediation can assist in the resolution and the settlement of international environmental disputes.

My experience with Canadian-United States negotiations of an environmental nature dates back to my 1969 service in the Department of State where I was both the counsel to the U.S. section of the United States-Canadian International Joint Commission and also the lawyer for the State Department.

I have also worked with the Arms Control and Disarmament Agency and in these positions I have had the opportunity to participate in and observe a number of bilateral and multilateral negotiations which, I believe, are relevant to the current negotiations between Canada and the United States.

The work that we have done with EMI has given me further opportunity to review the way in which some international environmental problems can be dealt with. For example, in your State we were asked by the State planning commissioner in South Dakota to examine the possibilities of using mediation to deal with the construction of the MANDAN powerline.

My testimony this morning will not include a description or an assessment of the state of knowledge. I will not affix blame for the current situation or any other situation, and I will not attempt to parse the various suggestions to amend the Clean Air Act. Rather, as a lawyer emphasizing the legal part of this particular panel's work I will look at a number of aspects pertaining to the current negotiations. I view them in my role as a neutral as well.

My testimony will discuss the background to the negotiating process, a review of the applicable international law principles, a discussion of the relationship that should exist between the Clean Air Act amendments and bilateral discussions, and a brief description of some of the principles that I think should be included in any agreement that is negotiated by Canada and the United States.

Some of the other speakers on your list this morning, Mr. Chairman, will address some of the background of the negotiations, so I will pass over that.

In terms of relevant international law principles, starting with the trail smelter arbitration in 1938 and 1942, working through the U.N. Stockholm Conference Declaration in 1972, there has developed a body of law which is considered expository of existing international law, both by the United States and Canada, and which deals with the responsibility of States with respect to environmental activities under their jurisdiction that cause damage outside.

One of the important aspects of the negotiation of any bilateral agreement between Canada and the United States, then, will be the ways in which the national law in each country will be used to implement agreed international law principles.

The memorandum of intent of Aug. 4, 1981, which has been referred to by Senator Mitchell, although not considered a binding legal document by the parties, is also expository of existing principles of international law which I believe make it incumbent on Canada and the United States to enforce existing legislation to reduce transfrontier pollution and to develop new legislation where necessary.

The aspect of the relationship of the bilateral agreement to domestic legislation is very, very important. Each can learn and be shaped by the other. This was the procedure used in the negotiation of the 1972 Great Lakes Water Quality Agreement which established objectives internationally which were then enacted and transmitted into the revised domestic legislation, the Federal Water Pollution Control Act.

It would be a mistake, I believe, to view the revision of the U.S. Clean Air Act as something completely separate from the bilateral discussions and agreement. The two must proceed in tandem.

International negotiations, to be effective, should begin from the premise that the countries negotiating have a good idea of what each wants. Negotiation must also carry with it the expectation that the serious concerns of the other party or parties will be integrated into the international discussions and then into any relevant legislation.

It is important to recognize that, going into a negotiation with a final position which does not have any flexibility, is more like entering into a contract of adhesion—a take-it-or-leave-it contract such as an airline ticket, rather than an actual negotiation.

The first hearings I ever attended of this committee when I was with the Arms Control and Disarmament Agency, the hearings on the Nonproliferation Treaty were replete with references to consultations and discussions that the United States had with its NATO and EURATOM allies which helped shape our negotiating position on the NPT. And, I should add, also influenced the way we treated safeguards subsequently under U.S. law.

It would, I think, be fruitful to try to work out some of these issues during the period before the new legislation is enacted so they can be taken into account in both countries' legislation and then can be fed back into the bilateral discussions. This is not meant to argue for a delay in the negotiation of the Clean Air Act itself, but rather that a very close relationship should exist. Midcourse corrections can modify requirements in light of later information.

The working group structure which is now in place if properly used, I believe, provides a forum so that both governments can make the changes in their own legislation to reflect bilateral needs.

As the two governments work closer toward the negotiation of an agreement itself, there are a number of principles which I believe should form the basis for some of the provisions of the agreement, and I think it is worth mentioning them.

First, there should be the recognition—as I am sure there is—that further research is needed. There is also a need to develop a joint data base so that the two countries are talking about the same sort of information. This does not now exist.

The agreement, I believe, should contain agreed reductions in sulfur oxides and nitric oxides, and a specific schedule both in terms of the quantity and the timing of reductions should form part of the body of the agreement.

There should be a recognition of flexibility for means of achieving these reductions. This was mentioned earlier by Senator Mitchell. There should not be a specific system required as to how the reductions will be obtained, but rather so long as the schedules are met, the method is of less importance.

There should be means of annual reporting on the state of the reductions and carrying out of the agreement. This might be given to an institution such as the International Joint Commission which has similar responsibilities in the water field.

An independent body such as the IJC might also be given the responsibility to independently find facts.

Further, there should be a mechanism for review of the agreement, and I believe this should take two very distinct forms.

First, would be a review of the operation of the agreement itself to make any necessary midcourse corrections; and second, I believe, there should be a periodic review to factor in new scientific developments that affect the basic principles of the agreement. For example, any further research on the carbon cycle or the effect of CO_2 on global climate is something which could upset the way in which the agreement had been worked out and would require modifications.

Next, I believe that there should be appropriate mechanisms for implementation. This includes enforcement of the provisions of the agreement as well as substantive provisions designed to resolve or settle disputes that may arise as a result of the agreement. I think it would be naive to assume that such disagreements will not take place.

The working groups, I believe, should consider these aspects as a substantive part of the agreement and not leave it to the final clauses.

Finally, as in the 1972 and 1978 Great Lakes Water Quality Agreements, provision should be made for funding the activities which are required for the bilateral agreement.

In the negotiating process itself I believe that Congress, States, provinces, and private interests should be very closely involved as part of the negotiating group because they will be the ones to deal with the issues afterward.

A final aspect, Mr. Chairman, is the question of what to do during the interim period, and here one looks to the Clean Air Act within the United States as a mechanism. Section 115 of the Clean Air Act, in brief, provides that if the Administrator of the Environmental Protection Agency, upon receipt of reports, surveys, or studies, has reason to believe that air pollutants within the United States may be reasonably anticipated to endanger public health or welfare then, if there is a similarity between the legislation in Canada and the United States, the EPA Administrator can require a change in the State implementation plan to remove the emissions and cut down on the damage.

I believe it is unreasonable to expect that any country can have the same form of government or the same kind of legislation as does any other. Therefore, in the case of emissions in the United States the issue is can the Canadian Government through its own processes work out arrangements similar to the kind of relief suggested in the United States. A study that EMI carried out for both Governments indicated that it could be.

In conclusion, Mr. Chairman, this is a complex bilateral negotiation which depends on scientific data but cannot wait for scientific certainty. It requires realistic domestic legislation in both Canada and the United States, but in the framework of an international agreement.

Most of all, it demands an understanding that as pollution knows no borders, we cannot erect a bubble around the United States. Things get in and things get out.

These hearings and this committee, I believe, can help to develop recognition of this reality which, unfortunately, is not that well understood by all who are seriously grappling with the issue of long-range transport.

Thank you.

[Mr. Stein's prepared statement follows:]

Prepared Statement of Robert E. Stein

Mr. Chairman, thank you for the opportunity to testify before the Subcommittee on Arms Control, Oceans, International Operations and Environment of the Committee on Foreign Relations. The subject of today's hearing, the current negotiations between the United States and Canada on the subject of long range transport of air pollutants (acid rain) has become one of the most significant bilateral issues between the two countries.

My name is Robert E. Stein and I am President of Environmental Mediation International, an organization established to examine the uses of the technique of mediation to assist in the resolution of international environmental disputes. EMI is a nonprofit organization incorporated both in the District of Columbia and Ontario, Canada. We have been involved in research for both the Canadian and U.S. Governments on one aspect of the acid rain problem, the uses of Section 115 of the U.S. Clean Air Act.

My experience with Canadian-U.S. negotiations of an environmental nature dates back to my service in the Department of State where I was both the Counsel to the U.S. Section of the United States-Canadian International Joint Commission, and the lawyer for the State Department for Canadian-United States matters. There I participated in some of the background to the negotiation of the 1972 Great Lakes Water Quality Agreement. Prior to that time, I served in the Office of the General Counsel of the U.S. Arms Control and Disarmament Agency and was part of the delegation negotiating the Nonproliferation Treaty. I have also served as Acting Director of Studies at the American Society of International Law. In these positions I have had the opportunity to participate in and observe a number of bilateral and multilateral negotiations. And some of this experience is, I believe, very relevant to the current negotiations between Canada and the United States.

This is one of a number of energy related activities with environmental aspects which exist between Canada and the United States in which we have been interested. We were called in, for example, by the State Planning Commission of South Dakota to examine the possibilities of using mediation to deal with some of the issues surrounding the construction of the MANDAN Power Line. It is, therefore, my hope that based on our activities I can be of assistance to the Committee in its consideration of the negotiations on long range transport.

At the outset, I should make it clear that my testimony will not include either a description of or an assessment of the state of knowledge about long range transport and acid rain. Other experts have and will consider these issues. Also, I am not here to affix blame for either the current situation or particular acts of responsibility. Finally, I will not attempt to parse the various suggestions to amend the Clean Air Act, although the Act is a vital part of any attempt to control long range transport.

Rather, as an international lawyer, I believe it important to address a range of issues that are involved in the negotiation between Canada and the United States that were formally started last June. I do this from the perspective of my role as neutral, which is a view that is sometimes missing in negotiations in which the parties only are involved, and they are advocates.

In my discussion this morning I will address the following issues that all relate to the current negotiations:

1. The background to the negotiating process including obligations that may have been undertaken by Canada and the U.S.
2. A review of international law principles that applies to the discussions between Canada and the United States over long range transport of air pollutants.
3. A discussion of the relationship, if any, that should exist between the reauthorization of the Clean Air Act and the bilateral discussions.
4. A brief description of the principles I believe should be included in an agreement on long range transport to be approved by Canada and the United States.
5. The concept of reciprocity as it relates to the U.S. Clean Air Act and the use of domestic legislation.

History of Canadian-U.S. Negotiations On Long Range Transport

For some years now, Canada and the United States have recognized that the issues of long range transport of air pollutants was of concern to both governments. The two aspects of the problem have been considered in parallel—separately, but with recognition of the important interaction between them. The two tracks are international negotiation towards a bilateral agreement, and domestic legislation that exists in both countries.

On November 16, 1978, the United States proposed to Canada that "representatives of the two governments meet at an early date to discuss informally (a) the negotiation of a cooperative agreement on preserving and enhancing air quality . . . and (b) other steps which might be taken." The Canadian reply note the following day welcomed discussions and the development of an agreement on "principles which recognize our shared responsibility not to cause transboundary environmental damage, and which might lead to cooperative measures to reduce or eliminate environmental damage caused by transboundary air pollution." In July 1979, a Joint Statement on transboundary air quality by both governments recounted the bases of obligation such as the 1909 Boundary Waters Treaty and called for a number of specific principles that should form the basis on negotiations on a bilateral agreement.

In November 1979 both governments signed the ECE Convention on Long Range Transboundary Air Pollution. Finally, on August 5, 1980, the two governments signed a Memorandum of Intent (MOI) concerning transboundary air pollution. Two tracks were evident in this document when the governments announced their intention to develop a bilateral agreement which will "reflect and further the development of effective domestic control programs and other measures to combat transboundary air pollution" and to take interim actions available under current authority to combat air pollution. Among the interim actions which were included were the commencement of formal negotiations on a bilateral agreement by June 1, 1981.

Further, to combat transboundary air pollution both governments said they would—

(a) Develop domestic air pollution control policies and strategies, and as necessary and appropriate, seek legislative or other support to give effect to them;

(b) Promote vigorous enforcement of existing laws and regulations as they require limitation of emissions from new, substantially modified and existing facilities in a way which is responsive to the problems of transboundary air pollution; and

(c) Share the information and consult on actions being taken pursuant to (a) and (b) above.

Formal negotiations did begin in June of 1981. It was clear, however, that the two tracks of negotiation of a bilateral agreement, based on principles of international law, and the use of existing or revised domestic legislation were meant to be parallel-not separate. As will be noted later, there are some who view the two processes as separate and distinct, and consecutive rather than simultaneous. The Memorandum of Intent also clearly indicated the view of both governments that current legislation-rooted as it was in the problems of single source pollution is not adequate to deal with the problems of long range transport.

The Relevant International Law

These two tracks are influenced by the current state of international law. The bilateral relationship between Canada and the United States has been the focus of the development of some of the basic principles of international environmental law. Traditionally, one goes back to the Trial Smelter arbitration between Canada and the United States. Although a specific case without any "precedential value," this arbitration took place after the United States-Canadian International Joint Commission could not obtain agreement from governments on how to deal with the situation—a problem in which a smelter in British Columbia was emitting fumes that crossed the border and caused damage to the State of Washington.

In the well quoted dictum of that case, the arbitral tribunal stated that: "No state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties of therein, when the case is of serious consequence or the injury is established by clear and convincing evidence."

This principle was a basis for Principle 21 of the Declaration of the 1972 U.N. Conference on the Human Environment Meeting in Stockholm which stated:

"States have, in accordance with the Charter of the United Nations and the principles of international law, the soverign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or areas beyond the limits of national jurisdiction."

The Organization for Economic Cooperation and Development (OECD) has also developed principles dealing with transfrontier pollution. All of these are considered expository of existing international law by both the United States and Canada.

There are, however, problems with relying fully on these principles. International law has not refined these statements to answer the question of how much is too much. If the damage is actual, however, international law does provide a minimum standard. International law also relies heavily on domestic legislation to implement and carry out the principles of international law. Thus, one of the important aspects of the negotiation of any bilateral agreement between Canada and the United States will be the ways in which national law in each country will be used to implement agreed principles.

The Memorandum of Intent, referred to above, although not considered a binding legal document by the parties is also expository of existing principles of international law which make it incumbent on Canada and the United States to enforce existing legislation to reduce transfrontier pollution and to develop new legislation where necessary.

The Relationship of the Bilateral Agreement to Domestic Legislation

As was stated above, there is a close relationship between the two. Each can learn and be shaped by the other. This was the procedure used in the negotiation of the 1972 Great Lakes Water Quality Agreement which established objectives internationally which were then enacted into the revised domestic legislation. This synergistic relationship is crucial to the development of both domestic and international environmental law.

It would be a mistake to view the revision of the U.S. Clean Air Act as something completely separate from the bilateral agreement. The two must proceed in tandem, and the international negotiation should not begin with a U.S. position frozen by already enacted domestic legislation.

International negotiations to be effective should begin from the premise that the countries negotiating have a good idea of what each wants. Negotiations also carry with them the expectation that the serious concerns of the other party or parties will be integrated into the international discussions and then any relevant legislation.

As a participant in and observer of a number of bilateral and multilateral negotiations that the U.S. has been involved in over the past 15 years, it is important to recognize that going into a negotiation with a final position which does not have any flexibility is more like a contract of adhesion—a take it or leave it contract such as an airline ticket—than an actual negotiation. As an example, the hearings of this Committee for the Non-Proliferation Treaty—the first hearings I attended—are replete with references to consultations and discussions with our NATO and EURATOM allies which helped shape our negotiating position.

If Canada and the United States were to begin their negotiation with a newly enacted Clean Air Act, and it was desirable to modify it to consider long range transport issues, it is possible that the Administration could go back to Congress requesting a change. It is, however, unlikely. It would, I think, be more fruitful to try to work out some of these issues during the period before the new legislation is enacted so that they can be taken into account in both countries' legislation and then can be fed back into the bilateral discussions.

Therefore, I believe a close relationship should exist between the negotiations and the revision of the Clean Air Act. The Working Group structure, if properly used, provides a forum so that both governments can make changes in their own legislation to reflect bilateral needs. The form the legislation takes may be different, for Canada and the United States have different systems of government. The form it takes, however, is less important than the result. The Working Groups can also feed attitudes and data developed during domestic discussions into the bilateral process.

The International Joint Commission uses technical boards much to the same purpose, and they have, over a long number of years, proven an effective mechanism and forum for bilateral reviews of technical concerns between the two countries.

Principles for Agreement

Now that the negotiations have formally begun, but prior to the actual drafting of an agreement, it would be appropriate for both parties to agree on those principles which will both govern the negotiations and form the basis of the bilateral agreement on long range transport of air pollutants. Although somewhat general in nature, the following principles, I believe, should form the bases for some of the provisions of the agreement. It is clear that there will be others as well but these should be included.

a. There should be recognition that further research is needed. As the parties go forward each with their own research, there is a need to develop a joint data base. Without such a data base, it is difficult to be sure that both parties are talking about the same thing.

b. The agreement should contain agreed reductions in sulfur oxides and nitric oxides. The 1972 and 78 Great Lakes Water Quality agreements contained both specific and general objectives. This is one way to deal with it. The 1979 U.N. (ECE) Convention on Long Range Transboundary Air Pollutants contained in paragraph 2. the fundamental principle that the contracting parties . . . shall endeavor to limit, and as far as possible, gradually reduce and prevent air pollution including long range transboundary air pollution. This is a hortatory though desirable principle but should find its way into the preamble. As indicated above, a specific schedule both in terms of quantities and timing of reductions should be agreed to in the body of the agreement.

c. There should be a recognition of flexibility for means of achieving those reductions. Each country through its own mechanisms and its own system of government should be able to reduce emissions in the manner that it deems most appropriate. There should be a way of reporting the results, but it would not, I believe, be appropriate to mandate a specific form of reduction technology.

d. There should be a means of annual reporting on the state of the reductions and the carrying out of the agreement. This can be done directly on a government-to-government basis or might be given to an institution such as the International Joint Commission.

e. An independent body such as the IJC might be given the responsibility to independently find facts.

f. There should be a mechanism for review of the agreement. This should take two forms: (i) Review of the operation of the agreement itself to make any necessary mid course corrections and (ii) a periodic review to factor in new scientific developments that affect the basic principles of the agreement. For example, further research on the carbon cycle or the effect of CO_2 on global climate. If the scientific evidence indicating an increase in CO_2 and a warming trend continues to build, then the use of fossil fuel with whatever kinds of controlled technology, may, as painful as it seems, have to be rethought. At an appropriate time, Canada and the United States should review the requirements in the agreement to see whether they comport with this new scientific evidence.

g. There should be appropriate mechanisms for implementation. This includes both the issue of enforcement of the provisions of the agreement as well as substantive provisions designed to settle disputes which may arise as the result of the agreement. It is clear that the very fact that an agreement has been signed will not solve the problem of long range transport. Rather if it is carefully and effectively drawn, an agreement can provide a framework for the governments dealing with the problem. At the same time one should recognize that the environmental agencies in both government as well as various other state, provincial, and local authorities will have a very important role after the agreement is concluded. The Working Groups, I believe, should consider these aspects as a substantive part of the agreement and not leave them to "final clauses." The negotiations of the Law of the Sea Agreement treated dispute settlement in this way and is a good example.

h. Finally, as in the 1972 and 1978 Great Lakes Water Quality Agreements, provision should be made for funding the activities which are required under the bilateral agreement. Without this it is basically a paper agreement without any teeth. Although the constitutional provisions of each government must be observed, these kinds of provisions are desirable to ensure that best efforts will be used toward securing appropriate funding.

Reciprocity and the Interim Period

A final area that should be addressed is the issue of the ways in which the two governments conduct their affairs dealing with long range transport until an agreement is concluded.

The section of the U.S. Clean Air Act which is usually referred to is Section 115. This section states as follows:

"(a) Whenever the Administrator, upon receipt of reports, surveys, or studies from any duly constituted international agency has reasons to believe that any air pollutant or pollutants emitted in the United States cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare in a foreign country or whenever the Secretary of State requests him to so so with respect to such pollution which the Secretary of State alleges is of such a nature, the Administrator shall give formal notification thereof to the governor of the state in which such emissions orginate.

"(b) The notice of the Administrator shall be deemed to be a finding under Section 110(a)(2)(H)(ii) which requires a plan revisions with respect to so much of the applicable implementation plan as is inadequate to prevent or eliminate the endangerment referred to in subsection (a). Any foreign country so affected by such emission of pollutant or pollutants shall be invited to appear at any public hearing associated with any revisions of the appropriate portion of the applicable implementation plan.

"(c) This section shall apply only to a foreign country which the Administrator determines has given the United States essentially the same rights with respect to the prevention or control of air pollution occuring in that country as is given that country by this section."

In brief, this section provides that if the Administrator of the Environmental Protection Agency, upon receipt of reports, surveys or studies has reason to believe that air pollutants in the United States cause or contribute to air pollution that may reasonably be anticipated to endanger public health and welfare in a foreign country, formal notification shall be given to the Governor of the State in which the emissions originate. This will trigger the revision of the State Implementation Plan process.

Subsection (c) of Section 115 is the reciprocity clause which states that the section can only apply to those countries which the Administrator determines has given the United States essentially the same rights with respect to the prevention or control of air pollution "as is given that country by this section." What does this reciprocity provision mean?

I believe it is unreasonable to expect that any country can have exactly the same form of government or the same kind of legislation as does any other country. Therefore, in the case of emissions in the United States that potentially cause damage to Canada—or vice versa—the question should be less has the Canadian Government enacted standards identical to those in the U.S. Clean Air Act—but rather can the Canadian Government through its own processes, through its own form of government (based as it is on a parliamentary system with ministerial discretion that also gives considerable authority to the provinces) provide relief for the United States in a manner similar to the kind of relief suggested by the section. Only if this broader definition of reciprocity which includes both a substantive as well as a legislative aspect is used, is this section really meaningful.

In December 1980, The Canadian Parliament enacted amendments to the Clean Air Act designed to provide reciprocity with the United States.

It is, therefore, up to the Administrator of EPA to make a determination of whether reciprocity exists. A report that EMI carried out for both EPA and Environment Canada considered the uses of this section and found that it did have a role in Canadian-United States long range transport. Unless the substantive provisions of the Act contain viable reduction provisions, however, the section though procedurally relevant, is empty.

Mr. Chairman, in my statement I have tried to cover a number—perhaps too many—international aspects of the bilateral negotiations on long range transport of air pollutants. It is a complex area that both depends on scientific data but can't wait for scientific certainty. It requires realistic domestic legislation in both Canada and the United States but in the framework of an international agreement. Most of all it demands an understanding that as pollution knows no borders, we cannot erect a "bubble" around the United States. Things get in and get out. These hearings and this Committee can help to develop recognition of this reality which, unfortunately, is not that well understood by all who are seriously grappling with the issue of long range transport of air pollution.

Senator **Pressler**. Thank you very much.

I shall ask a question of any volunteer, or all of you, whichever you prefer.

Some of you have endorsed the Mitchell and Moynihan bills, S. 1706 and S. 1709. Do you know what the socioeconomic costs of these bills might be? Do we know how much improvement in the acid rain problem will really result from these measures? Will these improvements justify the socioeconomic costs? How will the cost be distributed, who will pay?

Mr. **Kamlet**. I will step in where angels fear to tread. There are several parts to that, let me try to break it down.

As I indicated in my testimony, I think there are some pretty good projections as to what the economic cost in terms of utility rate increases will be and what the distribution of those costs are going to be among the 31 Eastern States.

I think the point that Senator Mitchell made in that regard is very important. What we are really talking about is not an increase in cost in any absolute sense, but rather reallocation of the cost of doing business and the cost imposed on the natural resources of the Eastern United States and increasingly the West.

I think what we are talking about is on the one hand increased cost on customers of electric utilities, some impacts on coal-producing States and so forth, in various parts of the country. On the other hand we are talking about amenities, lifestyle, aesthetics, quality environment that are of concern and bear very directly on every American.

You cannot directly compare one set of costs with the other, $500 million of benefits to me, I do not think, would serve as ample justification for $500 million or even $400 million in cost to you. There are incommensurables and I think it is very difficult to quantify environmental benefits and directly trade them off against more traditional economic values.

But every indication that we have seen strongly suggests that the benefits of acid rain control will greatly outweigh the costs.

Senator **Pressler**. Do we have any estimates on costs?

Mr. **Kamlet**. Yes. The cost estimates—and I think the last exhibit, exhibit 9 to our prepared statement, contains a summary of the ICF projections, 1.9 percent average increase in utility rates. A total cost of $2.4 billion for the 31 Eastern States in the year 1990 when the Mitchell bill would take effect. In the year 2000, the utility rate increases are about the same. The absolute costs are about $1 billion more at that point because of inflation.

In terms of percentage increases in cost of electricity, impacts on coal production, the costs are very small, very small, single-digit kinds of figures. In fact, there is some evidence that the bill will actually improve the cost picture for coal production in coal-producing States. The demand for coal from many sources will most probably be greater as a result of the Mitchell bill than in its absence.

Mr. **Eakins**. A study in 1980 by the University of Wyoming for the EPA estimates that about $5 billion a year are being lost now. This is not the cost, this is the current loss. You might say in many respects the limited damages—it is getting to be catastrophic in a lot of ways, but it is still limited to what the potential may be.

Already this EPA study reported in 1980 shows that it is costing $5 billion a year in losses.

Senator Mitchell did say—and I should not run over it again—but he does admit that, "I do not consider the costs of acid precipitation strategy insignificant, neither do I consider the cost of damage insignificant."

I point out, of course, I think we have just seen the tip of the iceberg in this whole area.

In closing I would just like to say, Mr. Chairman, paraphrasing Abraham Lincoln, "The world will little note nor long remember what we say here, but generations to come will be affected by what we do here."

Senator **Pressler**. I am glad to have you on the panel because of the part of the country you are from.

I might ask the other two—and I am glad to have you here, too, because of the parts of the country you are from—in any event, is there a broader issue here than just the immediate one? Is there a threat to soil and water that goes to the basic issue of food production?

Mr. **Kamlet**. I think there very clearly is. One of the irreversible long-term impacts of acid deposition in North America and elsewhere in the world is the depletion of nutrients from soil, and long-term and probably irreversible damage to the productivity of soil.

This has implications both for forest productivity and for productivity of agricultural crops. It may be those impacts in the long term are by no means confined to the Eastern United States. It may represent the greatest cost of acid deposition if allowed to go uncontrolled.

Mr. **Stein**. I think that there are some results of acid deposition which we know better than others, and I think it will be a while before all of the answers are in.

That is why I think it is important that we proceed with research at the same time as we are proceeding with some of the other policy activities, including both the Clean Air Act within this country and the bilateral agreement, and that in each of those pieces of legislation or international agreement provision should be made for making the kinds of corrections which may come about as the scientific evidence becomes more apparent.

Senator **Pressler**. We started in our country with about 30 inches of top soil and today we are down to about 6 inches of top soil to grow our crops. That remaining 6 inches of top soil is now being threatened by pollutants from the air. We have a surplus of food in our country and we never think about shortages or famine.

However, I recently returned from Poland where they have a shortage and, believe me, the problems that leaders have in a country that has a shortage of food are completely different. There is nothing that rivals it.

We have been the breadbasket of the world. We are able to export grain. We have been able to produce on such a scale that the best-selling books in our society are diet books.

Therefore, I am very concerned about the Academy of Sciences' conclusions about the effect of such rain on the agricultural sector.

Let me ask you one more question before you get away. I was going to submit this one in writing but you can each give a summary answer to this question.

There are certain interests that suggest that the acid rain problem is a contrivance of the Canadians to sustain their nuclear power industry through electricity imports to the United States at the expense of the development of U.S. coal-fired powerplants.

Do you have any comments on this theory?

Mr. **Eakins**. I am not afraid to talk on that. They can conspire all they want to from my standpoint, but the problem is, we have a problem of our own, whether they have it or not. All we have to do—just to get a quick example of it—just slip up to Sudbury and you know they have a problem also.

Now, how the various industries, ours and theirs, manipulate and work is not my field, but Canada does have a very real problem and the United States is going to have a terrible problem if we do not start doing something.

Mr. **Stein**. I would just like to add that the energy relationships between Canada and the United States are very deep and very complex, have existed for some time, and are continuing to expand—not only coal or natural gas, or nuclear, but hydropower also, in which transmission lines cross the country in various places all along the border.

The evidence that I have been able to find—and it may not be all that much—does not give very much credence at all to the so-called "conspiracy theory." Rather, there is a concern within Canada for acid rain which cuts across party lines.

The individuals that I have spoken to have assured me that this is not a problem, and this is not the reason for their concern. But their concern is as they have articulated it, that of dying lakes and concern with productivity of their food and forest resources.

Senator **Pressler**. Incidentally, the MANDAN powerline is a hot issue in the Midwest, and that is Canadian power coming into the United States.

What did your group conclude, did you do a study about the MANDAN powerline?

Mr. **Stein**. We did not do a study of the MANDAN powerline itself and the environmental impacts. We were asked to come in by the South Dakota State Planning Commission in the event that the public utility commission approved it, which in January it did not. It was felt that there might be some disagreements both over the question of siting, over questions of easement on the juncture between North Dakota and Manitoba and within South Dakota. So that we were asked to try to familiarize ourselves with it so that we could possibly assist in resolving some of those.

But the public utility commission this January, as you know, decided that Nebraska Public Power had not demonstrated need. So, for the time being, the line is not being built.

Senator **Pressler**. Thank you very much.

Next I shall call the panel addressing economic impact issues, the Honorable J. Theodore Meyer, House of Representatives, Illinois General Assembly, Chicago, Ill.; Mr. Larry Reynolds, president, district 11, State of Indiana, United Mine Workers of America; Mr. William B. Harrison, senior vice president, Southern Co. Services, Birmingham, Ala.

I must limit witnesses to 8 minutes in their opening statements. They can summarize them in colorful language and submit their briefs for the record.

I will go from right to left, is that agreeable? Mr. William B. Harrison, senior vice president, Southern Co. Services, Birmingham, Ala.

STATEMENT OF WILLIAM B. HARRISON, SENIOR VICE PRESIDENT, SOUTHERN COMPANY SERVICES, BIRMINGHAM, ALA.

Mr. HARRISON. Thank you.

I, as the others in the hearing, will submit a formal statement for the record. I would like to supplement it or put it in perspective with my oral remarks.

I am very grateful for the opportunity to be present today and to represent the Edison Electric Institute and its member companies of the electric utility industry.

It appears to many of us in the electric utility industry that allegations are being made and blindly accepted implicating coal-burning powerplants, particularly in the Midwest, in the acidification which has been observed in certain lakes in Canada and the Northeastern United States.

The observed acidification of lakes is evidently the basis on which Canada has been advancing two propositions: one, the emissions from powerplants in the United States are causing harm in Canada and, two, the United States is not being aggressive enough enforcing emission reductions.

We believe that neither proposition holds up well under careful examination.

Though the true nature and extent of lake acidification is not known and the causes are not known, the presumption that powerplants are at fault has motivated proposed countermeasures applicable only to our industry. These countermeasures are ardently supported by environmental activists in both Canada and the United States.

The allegations have now gone far beyond the known facts and have created a wave of emotionalism which appears to have an undue influence on the Transboundary Treaty negotiations as well as our own internal legislative process.

In view of the extremely high cost of currently proposed countermeasures, without any assurance of commensurate benefits, it seems only prudent for both the United States and Canada to take the time and make the effort to discover the facts of the matter so that truly cost-effective measures can be implemented on both sides of the border if needed.

Toward that end, we endorse the concept of the Transboundary Treaty work groups. In order to function properly, however, they must follow protocols for investigation which are commonly accepted in the scientific community. This would involve rigorous attention to comprehensive, objective analysis, subjected to extensive peer review.

The objectives should be to determine the true causes and effects of acid precipitation and to evaluate and compare the cost effectiveness of alternative measures to mitigate any undesirable effects which might well include lake acidification.

Clearly, a comprehensive analysis of acid precipitation will examine other possible precursors in addition to powerplant emissions, including emissions from private homes and vehicles, other industries, and so forth. There are many meteorological, ecological, and economic questions which must yet be answered.

In this context we full support the acid precipitation assessment plan mandated by the Congress in the Acid Precipitation Act of 1980. We do not wish to use unanswered questions as an excuse for delay, as some have already implied in the hearing today. We have urged that research efforts be intensified so as to produce meaningful results as soon as possible.

We wish to emphasize that it will be necessary to pursue a well-planned coordinated effort by both government and industry, concentrating on carefully defined objectives.

The electric utility industry has been conducting relevant programs through the Electric Power Research Institute and the utility acid precipitation study program, and we would welcome opportunities to make information derived from these programs useful to the Transboundary Treaty work groups.

As pointed out in the formal statement, procedural problems have restricted such exchanges regardless of the scientific merit of the information, and it is our hope that such obstacles can be overcome in order to insure that all facts are appropriately considered.

Even with the purest of motives it is foolish and wasteful to implement assumed remedies for perceived problems without knowledge of the likely effects of the action being implemented.

To illustrate the point, let us imagine that every coal-fired powerplant in the Midwest is suddenly shut down. I do not believe there is anyone in the world who can state with reasonable confidence how much or when any reduction would follow in the acid precipitation in Canada of the Northeastern United States.

In the face of this level of uncertainty it is clearly premature for either country to adopt a strategy for control. There is even a principle involved to the effect that Canada should position its own environmental protection laws to be as restrictive as ours before asking us to become even more restrictive than we are at present, without clear evidence of need.

In summary, our appeal is for reason and intellectual honesty to prevail in the Transboundary Treaty activities. Let us diagnose the disease before we prescribe the cure. I urge that the subcommittee carefully consider the critical unresolved issues surrounding acid precipitation.

In enacting the Acid Precipitation Act of 1980, Congress recognized that additional research was an essential prerequisite for further action and instituted a program to explore the subject in a deliberate and methodical manner. We should permit this rational problem-solving approach to produce the information we so badly need.

The electric utility industry is willing to actively participate in all aspects of acid precipitation research which pertain to our operations, and we pledge full cooperation with the Government in analyzing the facts and developing cost-effective countermeasures where they are needed to protect the public interest.

Thank you very much, Mr. Chairman.

[Mr. Harrison's prepared statement follows:]

PREPARED STATEMENT OF DR. WILLIAM B. HARRISON

Committee members, ladies and gentlemen: My name is William B. Harrison; I am a senior vice president of Southern Company Services and am speaking today on behalf of the Edison Electric Institute (EEI). EEI is the national association of investor-owned electric utility companies in the United States. EEI's members serve 99.1 percent of all customers of the investor-owned segment of the utility industry and 77 percent of the nation's electricity users. EEI is vitally interested in the current "acid rain" debate. I would like to thank the members of the committee for giving me this opportunity to testify today to present the utility industry's views on the international aspects of this issue.

I. INTRODUCTION

The acid rain issue has been thrust into the limelight of United States-Canadian international relations in a number of forums, including transboundary treaty negotiations, Ontario's participation in Section 126 hearings, and a sophisticated lobbying and public relations program. In essence, Canada has launched a campaign to convince Congress to impose rigorous additional emission reduction requirements on U.S. sulfur dioxide sources in the name of preventing acid rain effects in Canada. In responding to this plea, Congress must consider two fundamental arguments by our northern neighbors and their representatives, First, they argue that the transport and deposition of U.S. emissions—particularly from coal-fired power plants in the Midwest—is demonstrably causing serious harm in Canada and that the harm is rapidly worsening. Second, they argue that the United States' current control efforts are inadequate—that, essentially, we have not been a "good neighbor" and have not done our share to clean up emissions which may be contributing to international damage.

EEI believes that both arguments are generally unsupported by fact and that the additional costs to domestic sources from such control actions cannot now be justified. Current scientific evidence does not support claims that an imminent crisis exists which requires the immediate, drastic action proposed by the Canadians and domestic environmentalists. The current results of the Treaty Negotiation Work Groups can neither delineate what environmental effects are due to acidification nor demonstrate whether emission reductions would ameliorate those effects. Careful planning and adequate funding of future research is essential in order to answer these questions.

Nor has the United States failed to do its part to control pollution. In fact Canada has just begun to consider the kind of comprehensive, mandatory, federally enforceable air pollution control system which has been the hallmark of U.S. regulation since 1970. We urge that Canada continue to improve its own air pollution control programs, as recommended by the Sub-committee on Acid Rain of the Canadian House of Commons.

II. THE TRANSBOUNDARY TREATY NEGOTIATION PROCESS

In 1980, the United States and Canada signed a Memorandum of Intent regarding transboundary air pollution. Through the Memorandum, both nations agreed to undertake treaty negotiations to explore international issues that may arise from transboundary air pollution in general and acid deposition in particular. In recognition of the scientific uncertainties involved, the Memorandum also established technical Workgroups in an effort to ensure that the negotiations would be based upon facts, not conjecture.

We strongly support the Memorandum's plan for exploring acid deposition and urge that it be coordinated with similar efforts being conducted by other public and private research teams. By bringing to bear the collective expertise of U.S. and Canadian scientists, the program should provide insights into unresolved issues relating to atmospheric transport and transformation, allegations of transboundary environmental impacts, and the need for and feasibility of mitigation measures.

The Workgroups have been meeting for approximately eighteen months. An evaluation of the work produced to date leads to two conclusions: first, that there is presently no rational basis for the design of a control approach requiring emission reduction from U.S. sources; and, second, that the technical Workgroups must slow their frenzied pace and follow a more methodical approach in order to properly assess transboundary air pollution.

A. Current Workgroup Results Do Not Suggest a Need For Immediate Emission Reductions

The Memorandum of Intent established four Workgroups. Workgroup 1—the Effects Workgroup—was to estimate the amount of reduction in acidic loading necessary to prevent the occurrence of adverse environmental effects. Workgroup 2—the Atmospheric Transport Workgroup—was to develop a method for relating these decreases in loading and reductions to precursor emission reductions. Work group 3—the Control Cost and Strategy Development Workgroup—was to prepare alternative control strategies designed to achieve these reductions. And Workgroup 4—the Legal and Institutional Workgroup—was to design alternative legal and institutional mechanisms to implement these strategies.

Unfortunately the Memorandum's initial formulation of the Workgroups' duties inappropriately assumed its own conclusion: namely, that emission reductions are the solution.[1] A review of the results produced thus far by the Workgroups and studies undertaken by other prominent scientists does not support the imposition of emission controls, and in fact constitutes a compelling argument in favor of conducting additional research before considering the feasibility of remedial measures. In essence, the Workgroups have had difficulty complying with the terms of the Memorandum because the facts do not support the "control now" conclusion.

Workgroup 1 was to determine the reductions in pollutant loading "necessary to protect identified sensitive areas." This task has proved to be quite formidable since it requires the formulation of appropriate sensitivity criteria, the identification of sensitive areas through application of the criteria, and a detailed investigation into the relationship between deposition loading and potential effects.

At present, the Workgroup's ability to generate this information is in doubt. The Workgroup's members have, for example, recognized that the relatively crude sensitivity analyses performed to date require considerable refinement.[2] Moreover, while the workgroup has sought to establish the relationship between atmospheric deposition and effects sought by the Memorandum, it is clear that extensive additional research must first be conducted.[3]

Workgroup 2 has also been unable to develop an analytical approach that would enable negotiators to identify emission reductions necessary to achieve the reductions in loading—as yet undetermined by Workgroup 1—called for by the Memorandum. The Workgroup attempted to develop that methodology by examining a number of long range transport models and by producing simplified matrices designed to relate the effects of different source areas to receptor (or impact) areas. At present, however the Workgroup has fallen far short of that goal:

> No model used by the Workgroup is capable of modeling acid rain—each models only sulfate (or sulfur);
>
> The different models disagree as to which source areas are of primary concern—the models cannot agree where controls would be needed;
>
> The variation between models is approximately as large as the predicted loadings—the predictions can not be separated from the "noise;" and,
>
> The group has no analytical or empirical basis for picking one model over another.

The fundamental inability of the Workgroup to develop a meaningful analytical method has been reflected in communications between Workgroup members as well as in comments filed by government and private parties.[4] As Dr. Volker

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[1] *See* Section II.B. *infra* for a more thorough discussion of this and other problems with the Workgroup process.

[2] In the workgroup's most recent report the authors observed that: To improve the [sensitivity] interpretations the next step will be to use more accurate soil chemistry and depth data for the United States. This could be accomplished with Soil Conservation Service county level survey data. The Canadian data base requires *much improved* soil chemistry information from non-agricultural areas. Once this has been achieved it will be necessary to carry out more spatially accurate computer mapping and analysis, in those areas of high or moderate sensitivity undergoing high atmospheric loadings of H_2SO_4. Only when this stage has been reached can the most significant comparisons be made; that is, between terrestrial/geographical characteristics and watershed chemistry.

Impact Assessment Working Group 1, *Phase II Interim Working Paper* 3-38 (October 1981) (emphasis added).

[3] In responding to questions raised by the Utility Air Regulatory Group, the co-chairmen of Workgroup 1's Aquatic Effects Subgroup acknowledged that * * * neither regression nor correlation methods are sufficient to demonstrate a cause and effect relationship for alleged acid-induced effects. What is also necessary is development and rigorous testing of a logical mechanism which explains the observed relationship. Such mechanisms must be viewed initially as an hypothesis.

G. Glass and T. Brydges, *Responses to Reviews of the Aquatic Impact Assessment Draft Interim Report II May-July 1981*, 23 (October 1981) (Supplemental Document II).

[4] Dr. Machta, U.S. Chairman of Workgroup 2, has indicated: We also believe that the approaches are * * * rational, but *we feel even more strongly that the uncertainties * * * make it premature to engage in real assessments * * **. Further, as noted above, we believe that it may be *many years before the transfer matrices are sufficiently credible to be used in policy assessment*.

Memorandum for Dr. L. Machta; Director, Air Resources Labs, NOAA, U.S. Chairman for Workgroup 2; to B. Niemann, EPA, "Acid Rain Models; Criticism" (April 8, 1981) (emphasis added). The Department of Energy has commented that: We appreciate the problems of presenting the state of knowledge in such a difficult area as atmospheric modeling. However, as you will note from our enclosed comments, we believe the report overstates the extent of our present ability to construct transport models, and does not sufficiently emphasize the importance of little understood phases of atmospheric chemistry that are likely to be essential to formulating any reasoned control strategies. For these reasons, we could concur with your critique that the report does not provide an adequate technical basis for assessing emission controls to reduce acid rain impacts.

Letter (and technical report) from A. W. Trivelpiece; Director, Office of Energy Research, U.S. Department of Energy, to D. L. Machta, U.S. Chairman Workgroup 2 (Nov. 5, 1981).

Finally, consultants for the Utility Air Regulatory Group remarked that: Our principal conclusion from both our review of the Workgroup 2 Phase II reports and our independent evaluation of the transfer matrices is that the long-term LRT models identified and evaluated to date are not currently suited for evaluating emission control alternatives to reduce acid deposition.

Dr. C. S. Burton, *et al.*, "A Review and Critique of the Work Group 2 Phase II Modeling Activities of the U.S. Canadian Transboundary Team," (SAI Report No. 82017, Prepared for the Utility Air Regulatory Group) (January 15, 1982).

Mohnen stated in testimony before the Senate last November: [A] control strategy based on *science* cannot be developed at this time * * * [t]he deposition predictions from long-range transport models, such as those selected by the U.S.-Canadian Working Group II in accordance with the United States-Canada Memorandum of Intent on Transboundary Air Pollution, are *not* up to the task, since they all—directly or indirectly—assume a linear relationship between emissions of sulfur/nitrogen compounds and sulfate/nitrate depositions * * * Based on our limited present understanding of acid rain, it is impossible to predict the changes, if any, in wet and dry deposition that the emission reductions * * * would have in the environmentally sensitive areas of the Northeast.[5]

Workgroups 3 and 4 have not developed control strategies to date. This is not surprising given the inability of Workgroups 1 and 2 to produce an analytical approach to determine the "necessary" provisions.

B. The Procedures Followed by the Workgroups Have Effectively Precluded Public Participation

The Workgroups' implementation of the analytical approach outlined in the Memorandum has been plagued with procedural problems.

First, the Workgroups have been laboring under unrealistically short deadlines that have interfered with the assimilation of available information and that have largely precluded meaningful comment from competent and knowledgeable scientists not in the Workgroups. Time periods allotted for peer review by the scientific community have been alarmingly short and public hearings to allow interaction nonexistent. The quest for expedition has also made serious consideration of the few extensive comments submitted nearly impossible.[6]

The second critical flaw in the process involves the Memorandum's inexplicable failure to provide for independent peer review of the Workgroups' reports and recommendations before negotiations begin. Apparently efforts are under way to organize an independent review process, but it is uncertain when, if ever, it will be completed; moreover, the negotiations commenced six months ago.

From the outset, critically important information has been developed in a "closed loop," without the appointment of an independent scientific panel to evaluate the accuracy of the Workgroup's conclusions. As a result, the validity of the few comments that have been offered by competent, outside professionals has been and will continue to be judged by the very authors whose work is under examination—a procedure which makes objective, critical evaluation unnecessarily difficult.

EEI's third concern springs from more substantive considerations and constitutes our most fundamental objection to the treaty negotiation process. We are deeply concerned that the remedial measures the Workgroups appear to be endorsing—sulfur dioxide emission controls—were ordained from the outset, and that many Workgroup participants simply viewed the Workgroup exercises as a means of ratifying and buttressing that conclusion. In part, the responsibility for the prejudgment may lie with the politically charged atmosphere that surrounded the drafting of the Memorandum of Intent. While acknowledging the critical need for an "improv[ed] scientific understanding of the long-range transport of air pollutants and its effects" the Memorandum's authors rather inappropriately concluded that * * * the best means to protect the environment from the effects of transboundary air pollution is through the achievement of necessary reductions in pollutant loadings.

As a result, critical issues that have yet to be resolved by the scientific community have been brushed aside.

At a minimum, the Workgroups should examine more thoroughly: (1) the multitude of natural and anthropogenic causes that may be responsible for harm often ascribed to acid deposition; (2) the chemical and physical limiting factors other than SO_2 levels that may determine sulfate formation; and (3) the results of recent research on long-range transport that suggest that the influence of local sulfates has been vastly underestimated.

We have one final objection to the approach the Workgroups have followed. It seems self-evident that the findings presented by the Workgroups to the treaty negotiators should be premised upon facts—not conjecture or speculation. Yet, in reviewing memoranda prepared by Workgroup 1, we recently discovered that this view is apparently not shared by certain Workgroup participants. In responding to concerns that EEI had raised regarding the factual foundations underlying Workgroup 1's phase report, the authors remarked that: We * * * recognize the difficulty in trying to draw conclusions [regarding the effects of acid rain] when the most important hypothesis are at a point where current tests fail to reject them outright, but more tests are needed before all scientists accept the explanations * * * [A] fundamental purpose of the U.S.-Canadian assessment has been to present the most current hypotheses about the effects of acid precipitation on aquatic resources. As such, the report includes *all hypotheses in the process of being tested.*[7]

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[5] Testimony of Dr. Volker Mohnen on S. 1706 before the Senate Committee on Environment and Public Works 3 (November 3, 1981) (emphasis in original).

[6] Currently, for example, both Workgroups 1 and 2 are preparing phase III reports—due in April 1982—even though external comments have only recently been solicited with respect to phase II. External comment was never actively solicited with respect to the Workgroups' phase I reports.

EEI has serious reservations regarding the Workgroup's focus on hypothesis, rather than fact. While the compilation of unproven hypothesis may constitute a valuable academic exercise, it provides an unsatisfactory foundation for the formulation of an intelligent transboundary air pollution policy. The selective presentation of such hypothesis could effectively mislead nogotiators and undermine the validity of any accord ultimately reached.

III. THE UNITED STATES HAS PIONEERED AIR POLLUTION CONTROL EFFORTS IN NORTH AMERICA

Before considering the second argument—that the United States has not done its share to control pollution, I would like to express my concern regarding the extensive public relations and lobbying campaigns sponsored by the Canadian federal and provincial governments.[8] I believe these activities raise serious questions concerning one country's intrusion into the policy making process of another.

A. The United States Has Led the Way in Pollution Control

There is little basis for contending that the United States has been remiss in sharing the burden of air pollution control in North America. The United States clearly has led the way in pollution control over the past decade.

In enacting the Clean Air Act Amendments of 1970 and of 1977, Congress established a comprehensive program to protect public health and welfare through the adoption and mandatory state implementation of National Ambient Air Quality Standards. Moreover, the Act imposes particularly stringent emission limits on major new and modified sources, on sources of hazardous pollutants and on motor vehicles. While the states generally enforce these laws, Congress has provided for federal and citizen oversight to ensure compliance with the Act's mandates. As a result of these measures, our air quality has improved dramatically and there have been substantial reductions in total emission loadings over what would have occurred in the absence of these measures.[9] These gains were made through the expenditure of billions of dollars annually.[10]

Canadian air pollution legislation employs a substantially different and less stringent approach. It does not generally authorize the establishment of mandatory air quality and emission standards nor does it provide for effective means for federal and citizen enforcement.[11] Control requirements are developed in an accommodative fashion between provincial governments and sources.

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[7] G. Glass and T. Brydges, *Responses to Reviews of the Aquatic Impact Assessment Draft Interim Report II May-July 1981* 30 (October 1981) (Supplemental Document II) (emphasis added).

[8] This campaign has included tours for journalists, politicians and others; handouts at border check points extensive use of the media and highly emotional printed material. Moreover, in the recently published "Still Waters" Report, the Canadian Parliament Sub-committee on Acid Rain states: The Sub-committee recognizes that the (Canadian) Federal Government and some Provincial Governments have been very actively publicizing the acid rain issue in the United States and that some significant progress is being achieved. We commend these efforts. However, we believe that an even greater effort is necessary. *The Sub-committee recommends that our public awareness and information program is necessary to generate public concern in the United States* about the acid rain problem and the threat it poses to the Canadian and American environments. *The present program should be continued and expanded* and consideration should be given to inviting influential American media representatives to Canada so they can be apprised of the transboundary effects of U.S.-sourced air pollution.

Id. at 100 (emphasis added).

[9] *See, e.g.* National Commission on Air Quality, "To Breath Clean Air" (March, 1981) (hereinafter cited as NCAQ Report). Between 1973 and 1978 nationwide average annual concentrations of carbon monoxide decreased 33 percent and sulfur dioxide concentrations decreased 20 percent. *Id.* The difference between current pollution levels and those that would have occurred without these basic elements of the Act are even more dramatic. *Id.* at 1-1.

[10] *Id.* at 1-4. The NCAQ reported $20 billion annually.

[11] More specifically, the Canadian Clean Air Act authorizes the establishment of advisory air quality objectives, Clean Air Act, Can. Stat. C. 47 § 4 (1970-71-72), and national emission guidelines, *Id.* § 8. While five provinces have incorporated the air quality objective, thereby making them enforceable in those provinces, there is no analogous federally supervised SIP program.

The differences between the Canadian approach and ours is epitomized by the fact that no Canadian sources are equipped with costly flue gas desulfurization units (scrubbers), while more than one hundred power plants throughout the U.S. have installed or are installing scrubbers and all new coal burning plants will be so equipped.[12] In a similar vein, Canada's automotive nitrogen oxide standard is less rigorous: 3.1 grams per vehicle mile (gpvm), in contrast with the 1.0 gpvm requirement generally applicable to 1982 American cars. Finally, although the United States' total emissions of sulfur dioxide exceed Canada's, Canada's per capita emissions are approximately *twice* that of the U.S. [13]

B. Canada Should Control Its Own Emissions First

Damage resulting from the acidification of Canadian Shield lakes is the most common "effects" claim cited in support of immediate regulatory action. Yet there is reason to think that these effects—if they are in fact related to air pollution [14]—are caused in substantial part by Canadian local sources. The Ontario Ministry of Environment, in its survey of nearly 2000 Ontario lakes, found that only 86 lakes were acidic and that "[a]lmost all of the acidified lakes are in the Sudbury area and are believed to have been *directly affected by local sources.*" [15] Increasingly, studies tend to support the importance of local sources of sulfate, and, by tenuous implication, the importance of these sources in the acidification of aquatic bodies. [16] For example Dr. Rahn of the University of Rhode Island has indicated: "Overall, the (sulfate) aerosol (measured during episodes) appeared to be strikingly eastern—at least 90 percent of the Mn/V ratios were purely eastern in summer; in winter the aerosol was somewhat more varied but still markedly eastern." [17] Summarizing his view of the significance of this new information Dr. Rahn wrote:

> [W]e [at Rhode Island] are staunch advocates of the importance of long-range transport of air pollution because of our research in the Arctic * * * But [through that research] we have quite accidentally produced some new data which cast doubt on part of the current picture, and, we believe, call for a more careful look at the entire system of sources and transport of acidity in the Northeast before major control action ascented toward a particular region is taken.

The Canadian federal and provincial governments repeatedly cite their own initiatives to implement new control programs as evidence that the United States should increase its own efforts. An examination of these claims, however, shows that they either represent plans for future efforts or steps tending to bring Canadian controls up to the level of our current requirements.[18]

Evolving evidence suggests the importance of the influence of local sources on air and water quality. Therefore the Canadian emphasis on transboundary air pollution may be misdirected; Canada may be on firmer scientific footing examining the impacts of domestic local sources.

IV. THE COSTLY PURSUIT OF EMISSION REDUCTIONS

EEI believes that public policy decisions cannot be made in an economic vacuum—a conclusion underscored repeatedly in Congress' recent budget debates.

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[12] As of 1980 over 100 scrubbers were operational or under construction at U.S. power plants. U.S. EPA, Utility FGD Survey: July–September 1980, EPA-600/7-80-29d (October 1980).

[13] Hearings on Acid Rain before the Senate Committee on Environment and Public Works in Augusta, Maine (statement of Canadian MP Ronald Irwin) (April 14, 1981).

[14] As indicated in Section II. B., the utility industry believes inadequate attention has been paid to non-air pollution sources of acidification.

[15] News Release Ontario Ministry of the Environment "Environment Ontario Hotline Service Provides Analyses on Acidity of 1,665 Lakes" (May 28, 1981) (emphasis added).

[16] EEI believes that the connections from emissions to sulfates, from sulfates to acid deposition and from deposition to effects are all extremely tenuous. Notwithstanding this, several recent publications point to the relative importance of local sources. *See e.g.*, R. W. Shaw, "Deposition of Atmospheric [illegible] from Local and Distant Sources at a Rural Site in Nova Scotia," 16 Atmos. Env'mt 337, 48 (1981); U.S. Department of Energy, Acid Rain: The Impact of Local Sources, (November 1980).

[17] Rahn, "Elemental Tracer and Sources of Acidity for the Northeast—A Statement of New Evidence" 2 (November 1981). Dr. Rahn added that the Sudbury plume was detectable in the samples.

[18] Most notably, Canadians point to the control plans for the Inco smelter at Sudbury, the future emission reduction requirements for the Ontario Hydro generating system, the recently enacted Canadian legislation designed to provide authority symmetric to Section 115 of our Clean Air Act, Clean Air Act § 22.1; House of Commons 1st Sess., 32nd Parliament, 29 Elizabeth II, 1980, Bill C-51, and the National Emission Guidelines for new power plants.

The Inco smelter emission reduction program widely cited by Canadian officials has yet to be fully implemented. It is noteworthy that in 1970 the province of Ontario ordered Inco to reduce its emissions from 6000 tons/day to 750 tons/day by 1978. It is currently emitting as much as 3800 tons/day and is now required to reduce its emissions to 2000 tons/day by 1983. J. M. Friedman, *Canadian Economic and Energy Factors Affecting the Acid Rain Issue* (1981). C-51 represents and attempt to duplicate the international air pollution protection afforded by Section 115 of our Clean Air Act. 42 U.S.C. §7475. The National Emission Guidelines for power plants are generally not mandatory and establish emissions limitations similar to New Source Performance Standards, which have long been mandatory in the United States. Finally, the Ontario Hydro emission reduction program heralded as a major step forward, if implemented, [illegible] the *first* control program which would result in the installation of a scrubber on a Canadian utility source.

The resolution of acid deposition issues is no exception. In an effort to quantify the costs of emission reduction measures that have been urged by the proponents of controls, EEI has asked ICF to analyze the economic impacts of acid rain legislation (S. 1706) that has been introduced by Senator Mitchell of Maine. While preliminary in nature, ICF's evaluation provides dramatic evidence of the crippling costs that would result from a major reduction program. Compliance with the reduction plan envisioned in the Senator's bill, for example, would cost approximately $7 billion annually (in 1982 dollars) by 1990, and by that date would have required cumulative capital expenditures of $26.2 billion. These expenses, of course, represent incremental costs beyond the more than $6 billion industry already spends annually on SO_2 controls alone.

V. CONCLUSION

In closing, I would like to thank the Committee for exploring the international aspects of the acid deposition question. In my testimony today I have sought to place the often emotional claims related to acid rain in perspective and to offer constructive comments regarding the conduct of the transboundary treaty negotiations. In an effort to ensure that these deliberations result in the development of rational international acid rain policies, I would like to recommend that the State Department consider several courses of action.

First, I urge that the transboundary treaty process be revised to incorporate an independent peer review of Workgroup reports prior to the initiation of treaty negotiations. The breakneck pace of the Workgroups' activities and the absence of any external oversight have effectively insulated the process from the searching scrutiny that should precede the adoption of such a diplomatic accord.

Second, in view of the considerable and mounting scientific uncertainty that surrounds the acid rain phenomenon, we recommended that the negotiations be held in abeyance pending the conclusion of the comprehensive Acid Precipitation Assessment Plan mandated by Congress in the Acid Precipitation Act of 1980.[19] It is imperative that the federal plan be adequately funded and that adequate consideration be given to the implementation of the program so that it produces meaningful information in a timely fashion. The results of a program in which Congress has invested so heavily should play a central role in the formulation of State Department positions—especially since the continuation of negotiations in the face of ongoing research could result in the drafting of a treaty quickly rendered obsolete or unnecessary. Our recommendation carries with it little chance for lengthy delay, since legislation calling for the expedited completion of the Assessment Plan's research program has been introduced in both Houses[20] and appears to command widespread support, including that of the Edison Electric Institute.

Senator **Pressler**. Mr. Harrison, thank you very much. I shall address questions to the entire panel, but I will next call upon Mr. Reynolds.

STATEMENT OF LARRY REYNOLDS, PRESIDENT, DISTRICT 11, STATE OF INDIANA, UNITED MINE WORKERS OF AMERICA, TERRE HAUTE, IND.

Mr. Reynolds. Mr. Chairman, my name is Larry Reynolds, I am an Indiana coal miner, and I serve as the elected president of district 11 of Indiana of the United Mine Workers of America.

The United Mine Workers of America represents over 250,000 working, retired, and unemployed coal miners throughout the United States and Canada. While our membership is heaviest in coal-mining communities east of the Mississippi River, we represnt underground and surface miners throughout the Western States, with members in Arizona, New Mexico, North Dakota, Colorado, Wyoming, Montana, and Utah.

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[19] *See* 42 U.S.C.A. § 8901 *et seq.* (1981 Pamphlet).

[20] *See* H.R. 5055 (introduced by Representative Rahall, November 19, 1981) and S. 2027 (introduced by Senator Robert Byrd, January 28, 1982).

I would like to thank Senator Lugar and this subcommittee for the invitation to speak today on the employment and economic impacts of the current legislative proposals regarding acid rain. In doing so, I will share with you the results of recent analyses performed by the United Mine Workers of three control strategies and the effects of those proposals on our jobs and the economies of those communities in which we live.

Acid rain options should be scientifically investigated as to the causes, the problems, and the solutions. Unfortunately, the verdict is still out on the scientific causes of acid rain.

The causes of increased acid rain are being blamed on increases of sulfur dioxide and nitrogen oxide emissions from the burning of coal and on emissions from automobiles.

However, it is easy to blame someone before precise scientific results are concluded, and new ones and not new ones are identified.

Our membership has a strong interest in the current congressional reauthorization of the Clean Air Act, both as workers and citizens. As the Nation's largest energy-producing union, we are concerned that our pollution control strategies recognize the need for a balanced energy development. The jobs of thousands of our members and the economies of the communities in which they live are affected by environmental decisions.

As citizens of both Canada where we represent thousands of coal miners in Novia Scotia and British Columbia, and the United States, we are concerned that business interests not override the clearly established need for clean and healthful air.

The UMWA has reviewed S. 1706, a bill sponsored by Senator Mitchell. In the course of reviewing this proposed legislation, we have also examined a study conducted by the Peabody Coal Co., assessing this bill's effect on the current coal production in 12 Eastern and Midwestern States.

Based on the analysis, the United Mine Workers has measured the impacts of the reported production losses on jobs. We have also measured, in dollar terms, the effect of S. 1706 on the economies of those 12 producing States.

The results of this study are summarized in Attachment A of my testimony. It reveals the following effects of S. 1706 on coal mining jobs and the overall economy.

Over 89,000 coal mining-industry employees would lose their jobs if the proposed acid rain program is fully implemented.

The economic loss to the Eastern and Midwestern coal-producing States as a result of the loss of these coal mining-industry jobs alone would be $2.29 billion.

The ripple effect in nonmining sectors of the economy would result in the additional loss of $4.3 billion and the coal mining and related losses in the 12-State region combined to a total of nearly $6.63 billion under S. 1706.

In this study, the UMWA adopted the projected coal production losses that Peabody estimates will occur if S. 1706 becomes the law. The Peabody study assumes that utilities would switch to low sulfur coal rather than retrofit their existing powerplants with scrubbers in order to meet the emission reductions required under the bill.

Given the fuel adjustment clause passthrough provisions and utility capital formation problems, this presumption is a realistic expectation of how utilities would respond to this acid rain mitigation plan.

Even assuming that 25 percent and 50 percent of the projected loss of high sulfur coal would not occur—instead of fuel switching scrubbers installed to some existing plants—the economic impact of S. 1706 would still be significant, $4.97 billion and $3.32 billion respectively.

Incidentally, our analysis of the job and economic losses incorporates Department of Labor and Department of Commerce statistics and the methodology of our study is amply described in the footnotes to attachment A.

In the United States, there are more than 14,000 UMWA members who are presently unemployed, with the greatest percentage of that unemployment coming from the high sulfur coal fields of the Midwest—Indiana, Illinois, Ohio, and western Kentucky, and in northern Appalachia. Many of these same States—Indiana, Ohio, and Illinois—have among the highest unemployment rates in the Nation.

Our analysis indicates that more than 15,000 coal mining industry jobs would be lost in Illinois alone if S. 1706 was passed. Similarly, 5,400 jobs would be eliminated in Indiana, better than 12,300 eliminated in Ohio, and more than 11,500 persons would become unemployed in Kentucky if the bill becomes law.

Accordingly, the International Union of the United Mine Workers, including our Canadian brothers and sisters, opposes the control program suggested by S. 1706.

A second acid rain control program has been proposed in the Senate. Senator Moynihan of New York has introduced S. 1709, which is similar to the previously discussed Mitchell bill in that it specifies the same 32 State region as the control area. There are other similarities such as the flexibility allowed to the States in implementing those reductions.

However, the Moynihan bill differs from the Mitchell bill by not specifying the amount of sulfur dioxide emission reductions required. Moreover, under the Moynihan bill, only about 60 large powerplants located in 16 of the 31 States included in the acid rain mitigation region would be required to reduce emissions. Most of those powerplants are located in Ohio, Kentucky, Indiana, Illinois, Tennessee, Missouri, Pennsylvania, and Michigan, all traditional market areas for eastern and midwestern coal.

At the request of the Senate Committee on Environment and Public Works and the House Energy and Commerce Committee—the two committees that are reviewing the Clean Air Act—the Congressional Office of Technology Assessment compared the emission reductions required under both bills.

The Mitchell bill would require a 44.8 percent reduction in SO_2 emissions from current levels, while the Moynihan bill would require a 36.4 percent reduction. These percentages reflect the overall emission reduction in the 31-State region.

The OTA analysis, which was presented as testimony in November, 1981 before the Senate Environment and Public Works Committee also compared the percent of sulfur dioxide emission reductions on a State-by-State basis. The UMWA has forecast coal production losses in 11 Eastern and Midwestern States based on a factor derived by the OTA analysis.

According to the UMWA forecast found as attachment B to my testimony, S. 1709 would have the same devastating impact on coal miner jobs and the economic viability of the areas in which we live, as does S. 1706.

Over 82,300 coal mining industry employees would lose their jobs.

The income losses would be greater than $2.11 billion annually.

The ripple effect in dollar terms of those coal mining industry employee job losses would be an additional $396 billion.

The total annual economic losses in the 11-State region analyzed would be $6.07 billion.

Many of these States analyzed already have crippling unemployment rates, particularly in their basic industry sectors. Passage of either the Mitchell or the Moynihan bill would aggravate that situation dramatically.

Congress had several goals in mind when the Clean Air Act was reauthorized in 1977. In the pursuit of cleaner air, Congress intended that all of our Nation's energy resources be developed, that employment opportunities be enhanced, and that the various regions of the country be given equal opportunities to compete for economic development.

Thank you very much for affording me this opportunity to testify before you today.

[Mr. Reynolds' prepared statement follows:]

PREPARED STATEMENT OF LARRY REYNOLDS

Mr. Chairman, members of the Subcommittee, my name is Larry Reynolds. I am an Indiana coal miner and serve as the elected President of District 11 of the United Mine Workers of America. The UMWA represents over 250,000 working, retired and unemployed coal miners throughout the United States and Canada. While our membership is heaviest in coal mining communities east of the Mississippi River, we represent underground and surface miners throughout the Western states, with members in Arizona, New Mexico, North Dakota, Colorado, Wyoming, Montana, and Utah.

Our membership has a strong interest in the current Congressional reauthorization of the Clean Air Act both as workers and citizens. As the nation's largest energy-producing Union, we are concerned that our pollution control strategies recognize the need for balanced energy development; the jobs of thousands of our members and the economies of the communities in which they live are effected by environmental decisions. As citizens, of both Canada (where we represent thousands of coal miners in Nova Scotia and British Columbia) and the United States, we are concerned that business interests not override the clearly established need for clean and healthful air.

I thank Senator Lugar and this Subcommittee for the invitation to speak here today on the empolyment and economic impacts of the current legislative proposals regarding acid rain. In doing so, I will share with you the results of recent analyses, performed by the UMWA, of three control strategies and the effects of those proposals on our jobs and the economies of those communities in which we live.

The UMWA has reviewed S. 1706, a bill sponsored by Senator Mitchell and several other United States Senators, including six members of the Committee on Environment and Public Works, within whose jurisdiction the Bill lies. S. 1706 is designed to reduce the effects of acid deposition by requiring a significant reduction in sulfur dioxide emissions in the states along and east of the Mississippi River. In the course of reviewing this proposed legislation, we have also examined the study conducted by the Peabody Coal Company assessing this bill's effect on current coal production in twelve eastern and midwestern states.

Based on the analysis, the UMWA has measured the impacts of the reported production losses on jobs. We have also measured, in dollar terms, the effect of S. 1706 on the economies of those same 12 producing states.

The results of our study are summarized in Attachment A. It reveals the following effects of S. 1706 on coal mining jobs and the overall economy:

Over 89,000 coal mining-industry employees would lose their jobs if the proposed acid rain program is fully implemented;

The economic loss to the eastern and midwestern coal producing states, as a result of the loss of these coal mining industry jobs alone, would be $2.29 billion;

The "ripple" effect in non-mining sectors of the economy would result in the loss of an additional $4.3 billion; and

The coal mining and related losses in the twelve state region combined to a total of nearly $6.63 billion under S. 1706.

In this study, the UMWA adopted the projected coal production losses that Peabody estimates will occur if S. 1706 becomes law. The Peabody study assumed that utilities would switch to low sulfur coal, rather than retrofit their existing power plants with scrubbers, in order to meet the emission reductions required under the bill. Given fuel adjustment clause "pass-through" provisions and utility capital formation problems, this presumption is a realistic expectation of how utilities would respond to this acid rain mitigation plan. Even assuming that 25 percent and 50 percent of the projected loss of high sulfur coal would not occur—instead of fuel switching, scrubbers would be installed at some existing plants—the economic impact of S. 1706 would be significant, $4.97 billion and $3.32 billion respectively.

Incidentally, our analysis of the job and economic losses incorporate Department of Labor and Department of Commerce statistics and the methodology of our study is amply described in the footnotes to Attachment A.

In the United States, there are more than 24,000 UMWA members who are presently unemployed with the greatest percentage of that unemployment coming from the high sulfur coal fields of the midwest—Indiana, Illinois, Ohio and western Kentucky—and in northern Appalachia. Many of these same States—Indiana, Ohio and Illinois—have among the highest unemployment rates in the nation. Our analysis indicated that more than 15,000 coal mining industry jobs would be lost in Illinois alone if S. 1706 was passed. Similarly 5,400 jobs would be eliminated in Indiana, better than 12,300 eliminated in Ohio, and more than 11,500 persons would become unemployed in Kentucky if the bill becomes law.

Accordingly, the International Union of the UMWA, including our Canadian brothers and sisters, opposes the control program suggested by S. 1706.

A second acid rain control program has been proposed in the Senate. Senator Moynihan of New York has introduced S. 1709, which is similar to the previously discussed Mitchell bill in that it specifies the same 31 state region as the control area. There are other similarities such as the flexibility allowed to the states in implementing those reductions. However, the Moynihan bill differs from the Mitchell bill by not specifying the amount of sulfur dioxide emission reductions required. Moreover, under Moynihan, only about 60 large power plants located in 16 of the 31 states included in the acid rain mitigation region, would be required to reduce emissions. Most of those power plants are located in Ohio, Kentucky, Indiana, Illinois, Tennessee, Missouri, Pennsylvania, and Michigan, all traditional market areas for eastern and midwestern coal.

At the request of the Senate Committee on Environment and Public Works and the House Energy and Commerce Committee—the two committees that are reviewing the Clean Air Act—The Congressional Office of Technology Assessment (OTA) compared the emission reductions required under both bills. The Mitchell bill would require a 44.8 percent reduction in SO_2 emissions from current levels, while the Moynihan bill would require a 36.4 percent reduction. Those percentages reflect the overall emissions reduction in the 31 state region. The OTA analysis, which was presented as testimony in November, 1981 before the Senate Environment and Public Works Committee, also compared the percent of sulfur dioxide emission reductions on a state by state basis. The UMWA has forecasted coal production losses in 11 eastern and midwestern states based on a factor derived from the OTA analysis.

According to the UMWA forecast found as Attachment B to my testimony, S. 1709 would have the same devastating impact on coal miner jobs and the economic viability of the areas in which we live, as does S. 1706:

Over 82,300 coal mining industry employees would lose their jobs;

The income losses would be greater than $2.11 billion annually;

The "ripple" effect, in dollar terms, of those coal mining industry employee job losses, would be an additional $3.96 billion; and

The total annual economic losses in the 11 state region analyzed would be $6.07 billion.

The employment and economic impact of S. 1709 is greater in Kentucky and Tennessee than those felt from S. 1706, while the effects are marginally less in the other states studied. And, as you can readily see, the total impact on the coal mining industry in the midwest and eastern coal producing states is extraordinary.

Many of these states analyzed already have crippling unemployment rates, particularly in their basic industry sectors. Passage of either the Mitchell or the Moynihan bill would aggravate that situation dramatically.

Finally, the staff of the National Governors' Association has drafted a proposal which is being discussed as a "compromise" acid rain control measure. The staff draft isolates a 23 state eastern and midwestern United States region and develops an incremental two phase program for reducing SO_2 emissions. The second phase of the proposal would require a 5 million ton reduction in sulfur pollutants by 1990 from current emission levels. Since SO_2 emissions are expected to rise modestly over the next few years on a nationwide basis, this program then would effectively require a 7 million ton annual reduction when it is in full force and effect. Peabody and the Consolidation Coal Company have conducted separate analyses of this draft proposal and conclude that anywhere from 191 to 222 million annual tons of high sulfur coal would be displaced by the implementation of the NGA proposal. Based on that production displacement forecast, we have concluded that between 67,000 and 80,000 coal mining industry jobs would be lost by the program with total economic impact of between $5.05 and $5.97 billion. As before, copies of these analyses are appended as Attachment C to my testimony.

We understand that the National Governors' Association has not yet formally adopted this proposal and will be considering it in its late February meetings. This proposal is no compromise from our standpoint and we urge the NGA to take a long, critical, and jobs oriented look at it before it suggests adoption of the proposal by either chamber of the United States Congress.

Congress had several goals in mind when the Clean Air Act was reauthorized in 1977. In the pursuit of cleaner air, Congress intended that all of our nations' energy resources be developed, that employment opportunities be enhanced and that the various regions of the country be given equal opportunities to compete for economic development. Adoption of any acid rain strategy that disrupts traditional coal markets, brings about wholesale unemployment and favors one part of the nation over another is wholly inconsistent with these goals. The UMWA opposes any such legislation.

Thank you very much for affording me this opportunity to testify before you today. On behalf of my UMWA brothers and sisters in the United States and Canada, I urge you to consider the results of our analysis of these acid rain control programs before you take any action. If you have any questions, I will be glad to answer them.

[Attachment A]

EMPLOYMENT AND ECONOMIC IMPACTS OF S. 1706 IN COAL PRODUCING STATES; NOV. 2, 1981

States	Total tons of coal displaced (×10³) under S. 1706 [1]	Average annual tonnage output per coal mining industry employee [2]	Coal mining industry employee job losses	Total annual coal mining industry employee economic losses (×10⁶) [3]	Indirect economic losses multiplier [4]	Total annual indirect economic losses (×10⁶)	Total annual economic losses (×10⁶) [5]
Alabama	12, 289. 4	2, 422	5, 074	$130. 4	2. 22	$289. 6	$420. 0
Illinois	45, 260. 9	2, 912	15, 543	398. 5	2. 25	896. 7	1, 295. 2
Indiana	24, 677. 8	4, 570	5, 400	139. 3	1. 40	195. 0	334. 3
Iowa	317. 0	4, 059	78	2. 0	2. 64	5. 2	7. 2
Kentucky	34, 632. 8	2, 992	11, 575	297. 2	1. 96	582. 6	879. 8
Maryland	1, 067. 2	3, 029	352	9. 0	4. 70	42. 0	50. 9
Missouri	3, 024. 3	4, 069	743	19. 1	2. 77	52. 8	72. 0
Ohio	31, 382. 0	2, 548	12, 316	312. 9	1. 51	472. 4	785. 3
Pennsylvania	46, 289. 4	2, 583	17. 921	462. 1	1. 79	827. 1	1, 289. 2
Tennessee	6, 492. 6	2, 551	2, 545	65. 9	2. 21	145. 7	211. 6
Virginia	6, 768. 6	2, 261	2, 994	80. 0	3. 58	279. 2	357. 2
West Virginia	31, 259. 8	2, 122	14, 731	379. 8	1. 45	550. 8	930. 6
Total	243, 461. 8		89, 272	2, 294. 1		4, 339. 0	6, 633. 1

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[1] Peabody Coal Company testimony on S. 1706 before the United States Senate Committee on Environment and Public Works, October 29, 1981.

[2] State average annual tonnage output per coal mining industry employee derived from the U.S. Department of Labor, Mine Safety and Health Administration's (MSHA) currently unpublished report on injury experience in coal mining, 1980. MSHA utilizes information provided by coal operators on a mandatory basis as required under the Federal Mine Safety and Health Act of 1977. All mine, plant and office employees' hours are assumed, as is an eight hour day and a 234 day work year. Figures are slightly understated since unionized surface mine production employees work 7.25 hours per day. Because all coal mining industry employees are included in this factor, it differs from more traditional "Miner productivity" statistics.

[3] United States Department of Labor, Bureau of Labor Statistics, Employment and Earnings, October, 1981 and National Survey of Professional, Administrative, Technical, and Clerical Pay, Marc 1981. Average annual earnings for coal mining industry employees is weighted between production and office workers.

[4] These economic losses multipliers reflect the average relationship in each coal producing state in the proposed Acid Rain Mitigation Region, between basic and nonbasic income. Mining, agriculture and manufacturing income comprise the basic sector; total community earnings less basic sector income constitute the nonbasic sector. Income information and total community earnings are taken from U.S. Department of Commerce, Bureau of Economic Analysis, Volumes 3 (Mideast), 4 (Great Lakes), 5 (Plains) and 6 (Southeast), Local Area Personal Income, 1974-79, June 1931. Table 5 "Personal Income for States, Counties, and Independent Cities of the Region, 1974-79" were used, with multipliers computed for the year 1979.

Higher multipliers reflect the greater percentage of support, non-basic services in the economies of those states. In those cases, basic industry supports a greater volume of services. Lower multipliers tend to reflect more industrialized-dependent economies.

This methodology for determining the average effect on non-basic income due to a change in income in the basic sector is equivalent to the methodology used by the Coal Extraction and Utilization Research Center at Southern Illinois University, Carbondale, Illinois in The Economic Impact of Western Coal in Illinois, June 22, 1979. The multiplier computed for Illinois coal field areas measures the average effect base income has on personal income and are comparable, for the last year included in the SIU study (1974), to those derived from the twelve states in this study.

The SIU analysis presumes that the non-base sector is the service sector and is dependent on the base sector. It should be noted that the impact on the base sector is immediate, whereas the impact on the non-base sector will occur over time.

[5] Totals may not add due to rounding.

[Attachment B]

EMPLOYMENT AND ECONOMIC IMPACTS OF S. 1709 IN COAL PRODUCING STATES

States	Total tons of coal displaced ($\times 10^3$) under S. 1709 [1]	Average annual tonnage output per coal mining industry employee [2]	Coal mining industry employee job losses	Total annual coal mining industry employee economic losses ($\times 10^6$) [3]	Indirect economic losses multiplier [4]	Total annual indirect economic losses ($\times 10^6$)	Total annual economic losses ($\times 10^6$) [5]
Alabama	8, 782. 4	2, 422	3, 626	$93. 2	2. 22	$206. 9	$300. 1
Illinois	36, 785. 8	2, 912	12, 632	323. 9	2. 25	728. 7	1, 052. 6
Indiana	24, 333. 3	4, 570	5, 325	137. 4	1. 40	192. 3	329. 7
Iowa	50. 0	4, 059	12	. 3	2. 64	. 8	1. 1
Kentucky	39, 037. 6	2, 992	13, 047	335. 0	1. 96	656. 7	991. 7
Missouri	2, 487. 4	4, 069	611	15. 7	2. 77	43. 4	59. 1
Ohio	28, 884. 5	2, 548	11, 336	288. 0	1. 51	434. 8	722. 8
Pennsylvania	40, 803. 3	2, 583	15, 797	407. 3	1. 79	729. 1	1, 136. 4
Tennessee	7, 313. 3	2, 551	2, 867	74. 3	2. 21	164. 1	238. 4
Virginia	6, 768. 6	2, 261	2, 994	80. 0	3. 58	279. 2	357. 2
West Virginia	29, 908. 3	2, 122	14, 094	363. 4	1. 45	526. 9	890. 4
Total	225, 154. 5		82, 341	2, 116. 4		3, 963. 1	6, 079. 5

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[1] Tons of coal displaced was determined using a factor derived from the office of Technology Assessment testimony on S. 1706 and S. 1709 before the United States Senate Committee on Environment and Public Works, October 29, 1981, Table 4 "Comparison Between Mitchell and Moynihan Bills" and Peabody Coal Company testimony on S. 1706 before the United States Senate Committee on Environment and Public Works, October 29, 1981. This analysis assumes that if the required reductions in current sulfur dioxide emissions, calculated by OTA, displaces the amount of coal predicted by Peabody under S. 1706, then the required reduction in emissions under S. 1709 will displace an amount of coal production equal to a factor of the two percentages times the forecasted coal displaced under S. 1706. For example, S. 1706 will require Alabama to reduce emissions 41.0 percent below current levels; similarly S. 1709 will require 29.3 percent reduction in emissions. Peabody has determined that S. 1706 will displace 12,289,400 tons of coal production. Thus the coal production impact of S. 1709 using this analysis will be (29.3/41.0). 12,289,400 = 8,782,425.

[2] State average annual tonnage output per coal mining industry employee derived from the U.S. Department of Labor, Mine Safety and Health Administration (MSHA), Injury Experience in Coal Mining, 1980, Table 6 "Injury Experience by Degree, Worktime, and Production for Work Location and State at all Coal Operations in the United States, 1980". MSHA utilizes information provided by coal operators on a mandatory basis as required under the Federal Mine Safety and Health Act of 1977. All mine, plant and office employees' hours are assumed, as is an eight hour day and a 234 day work year. Figures are slightly understated since unionized surface mine production employees work 7.25 hours per day. Because all coal mining industry employees are included in this factor, it differs from more traditional "miner productivity" statistics.

[3] United States Department of Labor, Bureau of Labor Statistics, Employment and Earnings' October 1981 and National Survey of Professional, Administrative, Technical, and Clerical Pay, March 1981. Average annual earnings for coal mining industry employees is weighted between production and office workers.

[4] These economic losses multipliers reflect the average relationship in each coal producing state in the proposed Acid Rain Mitigation Region, between basic and non-basic income. Mining, agriculture and manufacturing income comprise the basic sector; total community earnings less basic sector income constitute the non-basic sector. Income information and total community earnings are taken from U.S. Department of Commerce, Bureau of Economic Analysis, Volumes 3 (Mideast), 4 (Great Lakes), 5 (Plains) and 6 (Southeast), Local Area Personal Income, 1974–79, June 1931. Tables 5 "Personal Income for States, Counties, and Independent Cities of the Region, 1974–79" were used, with multipliers computed for the year 1979.

Higher multipliers reflect the greater percentage of support, non-basic services in the economies of those states. In those cases, basic industry supports a greater volume of services. Lower multipliers tend to reflect more industrialized-dependent economies.

This methodology for determining the average effect on non-basic income due to a change in income in the basic sector is equivalent to the methodology used by the Coal Extraction and Utilization Research Center at Southern Illinois University, Carbondale, Illinois in The Economic Impact of Western Coal in Illinois, June 22, 1979. The multiplier computed for Illinois coal field areas measure; the average effect base income has on personal income and are comparable, for the last year included in the SIU study (1974). to those derived for the states in this study.

The SIU analysis presumes that the non-base sector is the service sector and is dependent on the base sector. It should be noted that the impact on the base sector is immediate, whereas the impact on the non-basic sector will occur over time.

[5] Totals may not add due to rounding.

[Attachment C]

EMPLOYMENT AND ECONOMIC IMPACTS OF NATIONAL GOVERNORS' ASSOCIATION STAFF PROPOSAL ON ACID RAIN

Region or States	Total tons of coal displaced (1[illegible])		Coal mining industry employee job losses		Total annual coal mining industry employee economic losses ($\times 10^6$)		Total annual economic losses ($\times 10^6$)	
	Peabody Coal Co.[1]	Consolidated Coal Co.[2]	Peabody Coal Co.[3]	Consolidated Coal Co.[3]	Peabody Coal Co.[4]	Consolidated Coal Co.[4]	Peabody Coal Co.[5]	Consolidated Coal Co.[5]
Arkansas/Oklahoma		180		64		$1.6		$6.0
Georgia/Tennessee		30		12		.3		1.1
Illinois	12,904.9	45,810	4,432	15,731	$113.6	403.3	$369.3	1,310.8
Indiana	23,729.7	25,860	5,192	5,659	133.9	146.0	321.5	350.2
Iowa	2,065.7	410	509	101	12.9	2.6	46.9	9.3
Kansas/Missouri/Oklahoma		5,950		1,759		45.0		171.1
Kentucky	17,877.1	30,780	5,975	10,287	153.4	264.2	454.2	781.9
Maryland	5,963.2		1,969		49.9		284.7	
Maryland/Pennsylvania		53,580		20,624		531.5		1,706.2
Missouri	15,803.2		3,884		99.6		375.4	
Ohio	37,277.6	31,840	14,630	12,496	371.6	317.4	932.8	796.7
Pennsylvania	39,628.3		15,342		395.6		1,103.7	
Tennessee	17,006.8		6,667		172.7		554.4	
Virginia	2,303.8		1,019		26.5		121.6	
West Virginia	16,547.6	28,370	7,798	13,369	201.1	344.7	492.6	844.6
Total	191,170.9	222,810	67,417	80,102	1,730.9	2,056.7	5,057.0	5,978.1

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[1] Peabody Coal Company analysis, January, 1982, of the National Governors' Association Staff Proposal on Acid Rain, January, 1982.

[2] Consolidation Coal Company analysis, January, 1982, of the National Governors' Association staff Proposal on Acid Rain, January, 1982. The maximum utility high sulfur coal displacement scenario was utilized in this analysis.

[3] Coal mining industry employee job losses was calculated for each state and region according to that areas' specific coal tonnage production and input of mine, plant and office employees' hours, derived from the U.S. Department of Labor, Mine, Safety and Health Administration, Injury, Experience in Coal Mining, 1980, 1981. See Footnote 2 accompanying "Employment and Economic Impacts of S. 1709 in Coal Producing States" for further information on the methodology.

[4] United States Department of Labor, Bureau of Labor Statistics, Employment and Earnings, October 1981 and National Survey of Professional, Administrative, Technical and Clerical Pay, March 1981. Average annual earnings for coal mining industry employees is weighted between production and office workers.

[5] Total annual economic losses includes economic losses in the coal mining industry and indirect economic losses due to the multiplier effects of the initial losses in coal mining sector. The multiplier effect is unique for each area, reflecting the degree of industrialization and/or supporting services in the particular economics. See Footnote 4 accompanying "Employment and Economic Impacts of S. 1709 in Coal Producing States" for further information on the methodology.

Senator **Pressler**. Thank you very much.
Mr. Meyer?

STATEMENT OF HON. J. THEODORE MEYER, HOUSE OF REPRESENTATIVES, ILLINOIS GENERAL ASSEMBLY, CHICAGO, ILL.

Mr. **Meyer**. Thank you, Senator. May I submit my written statement for the record and summarize my remarks?

Senator **Pressler**. Without objection it is so ordered.

Mr. **Meyer**. Good morning, Mr. Chairman.

My name is Ted Meyer, I am a member of the Illinois General Assembly serving in my seventh term.

By way of introduction and credentials to support my statement I would like you to know that I chair the house committee on energy and environment. I am founder and former chairman of Midwest Legislative Council on the Environment, and I have been awarded the Federal EPA Environmental Quality Award by region 5 of the USEPA.

More recently, I acted as one of the principal spokesmen in two separate meetings of bipartisan meetings of Illinois legislators with members of the Ontario Provincial Parliament.

I appreciate this opportunity to contribute to the congressional debate on the topic of transboundary air pollution As an elected representative with a strong record in environmental matters, I would like to say that the topic of how governments can work together to deal with the problem of pollution is an important topic.

In fact, the small group of Illinois legislators who initiated the meetings with Ontario thought that discussion at the State level could, in the future, contribute to governmental responsiveness that might be necessary. I would like to share with you some of the things that I have learned and some of the thoughts I have had as a result of these meetings, and the close communications I have had with Ontario and Canadian national government officials and others.

At this time I do not support any new, federally imposed regulatory scheme designed to address ecological effects attributed to transportation over long distances of select pollutants. Though there is much research going on, even Ontario scientists have told us of their problems of "path of pollution," or trajectory analysis, and that much research still needs to be done on the chemistry of air itself.

This does not convince me that soil and water degradation effects insensitive areas are wholly and predominantly, or even significantly attributable to chemicals which have been delivered from emissions very far away.

I do not deny that particular ecological systems are under stress due to soil and water chemistry changes. I accept the fact of Canadian scientists' statements that sulfur-based chemicals in the soils are one of the principal chemical problems. These sulfur concerns of Canadians clearly target the Ohio River basin power generation as the source of the problems.

Let me address a few words to the bills that are now before the Senate which deal with the acid rain. These bills have a devastating effect on the people of Illinois.

OTA staff have noted that some cause would exist for a time in which the replacement of emitters would be accomplished, presumably 30 years. One particular bill would have a direct cost of up to $120 billion and could create at least a 30-year economic effect on the business, jobs, and lives of the people in a handful of States. I would plead with this Congress that public decisionmaking must reach a more reasonable conclusion.

As a point of comparison on new regulatory schemes I would suggest that this Congress look closely at the public policymaking of our neighbors to the north, especially energy development, economic development, and environmental considerations are factors involved.

Canadian governments encourage the export of power to the United States. In June 1981, the Canadian Federal regulator, the National Energy Board, licensed Ontario Hydro to export power even though it was clear that this would result in an increased use of coal and increased sulfur dioxide emissions.

Ontario has published a program to retrofit scrubbers on at least two coal-fired existing units. Incidentally, all those coal-fired facilities contribute to a 20- to 30-percent surplus generating capacity which netted the Canadian corporation a $162 million gain from exports of power to the United States in 1980.

Ontario Hydro has also used this surplus in a program to get the many residences heating with inefficient fuel oil furnaces to switch to electricity.

Mr. Chairman, you might be interested to know that American consumers may in fact pay for part of Canadian scrubbers. The cost may be passed on before the scrubbers are in actual operation, the centerpiece of their regulatory program; perhaps even before the scrubbers are in actual operation and while the power facilities contribute to the pollution in Canada.

The Canadian examples I have given provide a comparative lesson to all of us.

Public policy decisionmaking by reasonable men and women often must weigh competing factors, and sometimes the environment wins and sometimes it loses.

I would only ask that the same fair consideration of all the factors be reserved and accorded by our Federal Government to the Midwestern and Illinois citizens just as they have been accorded to the Ontario and Canadian citizens by their national government.

For the acid rain debate in Congress I suggest that you use the Canadian National Energy Board for an example, where the Ontario consumer rates, balances of trade interest, and economic development interests outweighed their local and transboundary air pollution concerns. I sincerely believe that the facts support the Canadian decision.

In the end, a fully representative debate here can have a chance to resolve the conflicts as best as practicable.

I can offer no better comparisons on this latter point than our own Clean Air Act. The percent reduction compromise within the act now serves, for example, to mitigate economic and energy development distortions, while contributing to the improvement of new environmental technologies. Some of this improvement may now contribute to the Ontario Hydro plans to retrofit. I think that these provisions of the act have done a good job and will continue to do so, especially in light of other new source performance standards.

In my opinion, experience does allow a closer look at the contribution of local sources to the soil and watershed problems in sensitive areas.

Mr. Chairman, for the sake of brevity in time I think I would bring my remarks to a close. I realize that you have been here a long time

[Representative Meyer's prepared statement follows:]

PREPARED STATEMENT OF HON. J. THEODORE MEYER

Good morning Mr. Chairman and members of the Subcommittee. My name is Ted Meyer and I am an elected Representative to the House of the Illinois General Assembly.

In the way of credentials to support my statement, I'd like you to know that I chair the Committee on Energy and Environment in the Illinois House, I was a founder and former Chairman of the Midwest Legislative Council on the Environment, and I have been awarded the federal Environmental Quality award by the U.S. Environmental Protection Agency (EPA), among other environmental awards. More recently, I acted as one of the principal spokesmen in two separate meetings of a bipartisan group of Illinois legislators with Members of the Ontario Provincial Parliament.

I appreciate this opportunity to contribute to the congressional debate on the topic of transboundary air pollution. As an elected official with a strong record in environmental matters, I'd like to say that the topic of "how governments can work together" to deal with the problem of air pollution is an important topic. I certainly look upon the present U.S. negotiations with Canada as being an important contribution to this discussion. In fact, the small group of Illinois legislators who initiated the meetings with Ontario, also felt that discussion at the state level could, in the future, contribute to government responses that might be necessary. I would like to share with you some of the things I have learned, and some of the thoughts I have had as a result of these meetings and the close communications I have had with Ontario and Canadian national government officials and with others.

I think it important to mention at this time that the Illinois General Assembly enacted the first comprehensive state environmental protection law in the nation, I was cosponsor of the bill and proud to vote for its passage. I continue to work to support its implementation. The State of Illinois reputes its air pollution control program as one of the best in the nation, with sulfur dioxide reductions of over 30 percent being only one of the fine accomplishments of the last decade.

BLAME FOR SOIL AND WATER-SHED EFFECTS

I do not support any new, federally imposed regulatory scheme designed to address ecological effects attributed solely to the transportation over long distances of select pollutants—they have coined a phrase to gather all the causes, effects and other phenomena on this—its called "acid rain." Though there is much research going on, even Ontario scientists have told us of problems in their "path-of-pollution" or trajectory analysis, and that much research still needs to be done on the chemistry of the air itself. This does not convince me that soil and water-shed degradation effects in sensitive areas are attributable wholly, predominantly, or even significantly, to chemicals which have been delivered and result from emissions very far away.

I do not deny that particular ecological systems are under stress due to soil and water chemistry changes. I also do not deny that pollutants in the air, even dust particles, can "travel" distances. I also accept the Canadian scientists' statements that sulfur-based chemicals in the soil are one of the principal chemical problems, among others perhaps. Ontario scientists emphasized this by stating that they were not greatly concerned about nitrogen based compounds. These sulfur concerns of Canadians clearly target Ohio River Valley power generation as the source of their problems and they have asked us for immediate action to reduce SO_2 emissions by up to 75 percent.

Still, I completely reject at this time, any statement which attributes the blame for the accumulation, precipitation, or deposition of sulfates, on pollutant precursors emitted at very long distances from the alleged "receptor" sites. I believe that statements laying blame like this are not supported by the facts at this time, and that is not a reasonable conclusion—it is an arbitrary settling of the blame. In fact, I view this very arbitrariness as a threat to the fairness and equity of a good law.

REASONABLE PROPOSALS

Let me address a few words to the bills now before the Senate which deal with "acid rain," the Mitchell and Moynihan versions, in particular. These bills presume the blame to lie on sulfur dioxide emissions coming from Indiana, Illinois, Ohio and with minor blame being leveled against Missouri and others. I do not believe that these are reasonable measures.

These bills will have devastating effect on the lives of people in a handful of states. Almost all energy consumers in Illinois, for example, will face escalating energy costs far into the future, as these bills force Illinois utilities to displace our native energy resource-use with purchases of fuel outside of our economy, as the costs of retrofitting scrubbers on existing plants need recovery, and as outside suppliers and the transportation industry take advantage of their strengthened competitive position.

The Office of Technology Assessment (OTA) has already testified before another Senate Committee that the direct costs of a 10 million ton SO_2 emission reduction would be between $2 to $4 billion annually. OTA has also noted to my staff that these costs would exist for the time in which the replacement of the regulated emitters would be accomplished, presumably 30 years. This particular bill, with direct cost of up to $120 billion, could create, at least a 30-year economic effect on the businesses, jobs and lives, of the people in a handful of states. I would plead with this Congress that public decisionmaking must reach a more reasonable conclusion.

REASONABLE DECISION MAKING

As a point of comparison, I would suggest that this Congress look closely at the public policy-making of our neighbors to the north, especially when energy development, economic development and environmental considerations are factors involved.

Canadian governments encourage the export of power to the United States. In June 1981, the Canadian federal regulator, the National Energy Board, licensed Ontario Hydro to export power even though it was clear that this would result in an increased use of coal and increased sulfur dioxide emissions. The Ontario Provincial Government, for another example, has waived their own requirement in law for an environmental assessment on every major export project, and for others.

Fortunately, Ontario has published a program to control the emissions from their own Provincial government energy corporation, Ontario Hydro. The program will eventually help to limit Ontario's own contribution to their problems. Plans now call for Ontario Hydro to retrofit scrubbers on at least two existing coal-fired units. Incidently, all of these coal-fired facilities contribute to a 20–30 percent surplus generating capacity which netted the government corporation a $162 million gain from exports to the U.S. in 1980. This surplus capacity, which will probably exist into the next century, allows the government to run another "local source" control program. Ontario Hydro has used the surplus to support a program to get the many residences heating with inefficient oil furnaces to switch to electric heating.

The Ontario plans would probably bring retrofitted scrubbers into action no sooner than 1985, with 1986 more probable. Based upon Illinois experience, 1988 would be the year that brings normal scrubber operations. Even this date may be too early, however. In fact, Ontario officials just met with utility officials in Illinois last month, in order to gain something from our retrofit experiences.

Mr. Chairman, you might also be interested to know that for Ontario exports to the GPU system in the United States (to begin in 1985, if licensed and permitted), part of the costs for the Ontario scrubbers are to be passed on over the 10-year life of the contract. American consumers may, in fact, pay for part of the Canadian scrubbers, the centerpiece of their regulatory program, perhaps even before the scrubbers are in actual operation, and while the power facilities contribute to the pollution in Canada, and by Canadian doctrine, while they also contribute to U.S. problems.

COMPARISONS

The Canadian examples I have given here provide a comparative lesson to us all, I think—

> Public policy decision-making by reasonable men and women often must weigh competing factors, and sometimes the environment wins and sometimes it loses.

As an elected official, I would only ask that a fair consideration of all the factors be reserved and accorded by the Federal Government to Illinois and midwestern citizens, just as they have been accorded to Ontario and Canadian citizens by their national government. For the "acid rain" debate in Congress, I suggest you use the Canadian National Energy Board example, where Ontario consumer rates, balances of trade interest, and economic development interests outweighed their local and transboundary air pollution concerns. I sincerely believe that the facts support the Canadian decision.

Of course, reasonable decisions may eventually have environmental interests taking precedence in the proposed "acid rain" solutions. In this case, I will be satisfied as an environmentalist. I will also be satisfied as a public official. Here the representative debate would have had a chance to resolve the conflicts as best as practicable.

I can offer no better comparisons on this latter point then our own Clean Air Act. This Act stems from congressional action in 1963, 1966, 1967, 1970, 1977, 1980 and again in 1981 and now. The percent reduction compromise within the act now serves, for example, to mitigate economic and energy development distortions, while contributing to the improvement of new environmental technologies, some of this improvement to contribute now to the Ontario Hydro plans to retrofit scrubbers. In absence of facts to the contrary, I think these provisions in the Act do a good job, and will continue to do so, especially in light of the other New Source Performance Standards (NSPS) which call for each new emitter to meet cleaner standards.

LOCAL SOURCE CONTROL

In my opinion, our experience does allow a closer look at the contribution of "local source" to the soil and water-shed problems in sensitive areas. One might, for instance, consider a "local source" contribution from the INCO plant in Sudbury, Ontario to the soil and water-shed problems outside of Bracebridge, Ontario. As you know, the INCO nickle smelter and the neighboring Falkenberg smelting facility make the largest sulfur dioxide "bubble" emitter in North America and probably the world. Clearly, reductions in local source emissions will contribute immediately and directly to the quality of the air, and to the potential for the precipitation of chemical pollutants which can cause harm in sensitive soil and water-sheds.

I think that it is possible for two great nations, with the cooperation of some state and provincial governments, to help each other control the sulfur contributions of the sources more local to the problem areas that have been identified in Ontario and New England. Let me offer one approach which builds upon United States-Canadian discussions which began in 1978, and probably earlier, which may only now need the environmental angle to make it a viable national pursuit and international goal.

Let me suggest that negotiations with Canada focus on the mutual benefit of firm electricity exchanges that balance, *and I quote*, "such matter as economic effects, employment opportunities, balance of payments and the environmental impact of producing power for export."

INTERNATIONAL EXCHANGES

The following proposal leans very heavily on a shared, 1979, report of the U.S. Department of Energy (DOE) and the Canadian Department of Energy, Mines and Resources, from which I have already quoted. [United States/Canada Electricity Exchanges, February 1979, page C–8]. I recommend it as reading to all who are interested. Also attached to my statement is an excerpt from that report dealing with "Canadian Authorization Procedures."

Two vehicles of federal authority already exist to provide points of cooperation in any treaty; they are, the Canadian National Energy Board (NEB), and the Presidential Permitting procedures for international transmission facilities, under Executive Order 10485 (1953), as amended. In the case of the Presidential Permit process environmental impact is now the first concern of the United States.

Still, the Presidential Permit process and the NEB could be oriented to look more carefully at the international and local pollution effects of the export production and exchange system. With Canadian federal subsidy of the nuclear portions of these systems, Canadian federal pollution control becomes even more practicable.

Specifically, Congress should encourage a treaty which calls for:

(1) establishment of U.S. resources for the review of all existing and future Presidential Permits, as to their local source and transboundary pollution effects;

(2) establishment of Canadian National Energy Board resources devoted to transboundary pollution concerns;

(3) restraint on new and existing transmission permits for firm purchase contracts where a significant pollution problem would be created in the area producing the power, or where a clear and significant transboundary pollution problem might result;

(4) Canadian licensing which allows some degree of rate preferences for use of surplus provincial power to displace Canadian "local sources";

(5) limitation of any Presidential facility permits and export licenses to the period necessary for replacement with domestic generating capacity, preferably scrubbed and washed, coal-fired facilities;

(6) establishment of utility programs directing firm power imports to be used for oil and "local source" displacement, to the extent practicable; and

(7) Canadian use of returned power surpluses at contract termination, for the displacement of their own residential contributions to air pollution, and the displacement of unscrubbed, coal-fired facilities, and others which contribute to environmental pollution.

Any treaty should also work toward resolving related electricity exchange problems stemming from increased use of larger, interrelated energy systems. The President should, for example, ensure that additional system ties in Canada do not threaten the international relationships and that cost schemes are fair to U.S. utilities, investors, and American consumers.

Let me highlight these points I have made. First, American imports broach larger issues than immediate cost considerations. The original Presidential Permit process began in 1939, under the last Roosevelt Administration, probably as a control measure on a strategic good—energy. DOE now looks, apparently, at reliability, dependency, and fuel type issues under the present permit process, though environmental issues have been a first concern recently. Yet, this whole process takes on even greater implications with 1985 imports expected to be over 40 times larger than in 1973.

Secondly, international "exchanges" can take on broader meanings. National Energy Board (NEB) cooperation on possible transboundary effects can support an apparent interest of Canadian politicians in protecting sensitive areas from additional own source chemical loadings. When the loading from export generation might obviously be significant, the United States could cooperate to restrain facility use. Where the NEB sees transboundary issues, they might restrict a license. The NEB could, for example, provide that uses for local source displacement through electricity sharing between the Provinces obtain some reasonable degree of preference over export.

Finally, displacement and replacement options already appear to be practical and political goals. For instance, the GPU export application is for 10 years, though in the past, licenses were usually shorter, on the order of 5–10 years. You'll recognize that a 10–12 year period is a reasonable planning period for the construction of other generating facilities. In fact, overall Canadian national power policy even calls specifically for the NEB "to provide for exports of firm power for limited periods to make possible the step by step construction of the most economical generating facilities." [United States/Canada Electricity Exchanges, February 1979, page C–5.] The New England/Maritimes response paper on exchanges also noted that Canadian pricing policies "led to a feeling that no significant saving can thereby be achieved and thus proposals for development in the U.S.A. should be favored over external purchases when there is a clear alternative." They also noted that "[A] proposal to purchase power * * * may appear less desirable to a prospective buyer than installing its own facilities because such generating capacity will have to be replaced by the buyer at the end of the contract period." [Electricity Exchanges, page D–7.]

MUTUAL BENEFITS

National and international energy, economic and environmental interest can now serve to outweigh the uncertainties for these electricity exchange transactions.

For U.S. interests, the cooperation I have outlined could open up a huge market for the environmentally sound use of Illinois and U.S. coal resources, it provides a direct air pollution control program for Canadian and U.S. local sources as a better option than the imposition of new and uncertain regulatory schemes on Illinois and the midwest, it can act to stimulate domestic jobs in the construction sector, improve domestic tax bases, and limit the dependence on foreign oil sources.

Through cooperation, Canada would see a cash subsidy for their already high energy consumption requirements, economies of scale for the continued development of their energy industries, a contribution to their overall economic stability through balance of trade efforts, and a solution for their "acid rain" concerns.

Still, Mr. Chairman, there is one drawback to these proposals. The Canadians and Americans who will draw the benefits, may also see their energy costs increase somewhat, at least for an interim period. I think this is only reasonable and fair.

I appreciate the opportunity to make these remarks. I sincerely hope that they can contribute to improvement in Canadian relations on several fronts, but in particular, on transboundary air pollution problems. Thank you.

[Attachment]

JOINT UNITED STATES/CANADA ELECTRIC POWER INTERCHANGE STUDY

CANADIAN AUTHORIZATION PROCEDURES: JULY 17, 1978

In Canada regulatory authority over exports of electricity and the construction and operation of international power lines is exercised by the National Energy Board, an agency of the Federal Government. An application to the Board, whether for a certificate to construct an international line or for a licence to export power, requires a public hearing. At the hearing, interested parties may present evidence and arguments for or against the application. The hearing is normally held before a panel of three Board Members. Their decision is handed down subsequently as a report which describes the application, summarizes the evidence, states the decision, gives the reasons for it, and sets out the conditions to be included in any certificate or export license to be granted.

A decision by the Board to grant a certificate or licence is not effective until it receives the approval of the Governor General in Council. (In Canada the Governor General represents the Queen as Head of State.) This official government approval, however, is not required if the Board decides to reject the application.

The Board may dispense with a public hearing in cases where an international power line would be of very low capacity—less than 5 megawatts, or where the export would be small—less than 4 megawatts or 20 gigawatt-hours of energy per year. In these cases, government approval of a Board decision is not required.

The Board may also authorize exports without a public hearing and without government approval if emergency conditions have arisen that may cause interruptions in the supply of power to consumers in the United States served by facilities interconnected with Canadian systems.

In examining applications for export licences, the Board divides proposed exports into two broad classifications: firm power and interruptible energy. Firm power is power intended to be available at all times specified by an agreement. Interruptible energy is energy that may be interrupted or curtailed at the option of the supplier. It is obvious that an application for the export of firm power warrants a more comprehensive examination than one for the export of interruptible energy.

The National Energy Board Act requires the Board, in considering an application, to satisfy itself that the quantity of energy to be exported is surplus to reasonably foreseeable Canadian requirements, and that the price to be charged is just and reasonable in relation to the public interest. In addition, the Board is required to consider all matters that appear to it to be relevant.

To ensure that an export price is just and reasonable, the Board has developed three criteria that the price must meet. Firstly, it must cover fully the cost of the energy to be exported. Secondly, it must not be less than the price to Canadians for comparable service. Thirdly, it should not be materially less than the least-cost alternative available to the U.S. purchaser.

The clause in the Act requiring the Board to consider all matters that appear to it to be relevant provides wide powers of enquiry. It enables the Board to scrutinize every aspect of an export application. It is interpreted as embracing such matters as economic effects, employment opportunities, balance of payments, and the environmental impact of producing the power for export.

The Act limits export licences to a maximum term of 25 years. Most licences, however, are issued for a term of 5 to 10 years.

The Board usually issues separate licences for interruptible energy, firm power, short term firm power and wheeled power. Licences for exports over major system interconnections traditionally allow the exporting utility fairly wide latitude to arrange individual transactions. The licence sets maximum limits, usually per year or per consecutive 12 months, and prescribes minimum prices or pricing formulae. The licensee is then free to negotiate transactions within these limits and subject to the general conditions of interconnection-type agreements filed at the hearing. Any amendments to such agreements or to the prices during the term of a licence are subject to the approval of the Board through the mechanism of an interim filing. Certain classes of short term firm power sales under an export licence are also subject to individual approval when negotiated.

No licence is required to import power into Canada.

In considering an application for certification of an international power line, the Board examines the availability of power for the line, the existence of markets, the economic feasibility of the line, its general financing, and any public interest that may be involved. Since July 1974, every applicant for a certificate is required to provide an assessment of the environmental impact of the facility for which authorization is requested.

Senator PRESSLER. Thank you very much.

Let me address some questions to the panel.

Your statements indicate that the cost of imposing stringent federally mandated emission standards on existing coal-fired powerplants would be prohibitive.

Could you elaborate on what these costs would be?

Mr. HARRISON. May I?

Senator PRESSLER. All right.

Mr. HARRISON. In fact, I would like to quote from the formal statement I have already submitted for the record. In an effort to quantify the cost of emission reduction measures that have been urged by the proponents of controls, EEI has asked ICF—this is the same contractor referred to earlier in testimony we have heard—to analyze the economic impacts of acid rain legislation in connection with the bill introduced by Senator Mitchell of Maine.

While preliminary in nature, ICF's evaluation provided dramatic evidence of the crippling costs that would result from a major reduction program. Compliance with reduction plans envisioned in the Senator's bill, for example, would cost approximately $7 billion annually in 1982 dollars by 1990, and by that date would have required cumulative capital expenditures of over $26 billion.

These expenses, of course, represent incremental costs beyond the more than $6 billion industry already spends annually on SO_2 controls.

Now, you will notice that the numbers I am quoting are quite different from those you heard earlier, and even though they were done by the same contractor they were done with different assumptions. As you know, macroeconomic modeling has the feature that the results you get depend on the assumptions you make. The assumptions that were referred to in the earlier testimony did not conform to the conditions set forth in the Mitchell bill.

Whereas we believe that these do, and there are substantially higher economic impacts.

I would also point out that even though these costs are distributed among all the companies affected, there are local communities and local companies that will be impacted much higher than what might be called an average increase.

Thank you.

Senator PRESSLER. Do any of you have something to add to that?

Some of you cite the new source performance standards as a reasonable solution to the call for cleaner air standards. However, is it not true that in 1979 only 8 percent of all coal-fired electricity in the United States came from powerplants with scrubbers?

Is it also true that even in 1995 plants now in existence will account for 73 percent of sulfur oxide emissions?

How many years do you estimate will it be before the new source performance standards will have any effect on sulfur oxide emissions?

Mr. **Harrison**. I presume that is directed more to the utility industry. I cannot confirm or deny the numbers you have quoted, but you do recall that new source performance standards are applicable to new plants, to new sources.

So, as the existing powerplants are retired, their replacements will altogether be bound by the new source performance standards.

The same is true for any incremental additions in capacity that go beyond just retirement of old plants. So it is obvious that as time goes on, the transfer to those covered by NSPS will be incrementally on the increase. Most powerplants are designed for a 30-year life. Let us assume that those now in existence—just for purposes of discussion—have half of their life remaining.

So, in another 15 years all of them, using this kind of simplistic logic, will have been replaced by new source performance standard facilities, essentially all of them.

Does that address your question, sir?

Senator **Pressler**. Yes; thank you.

Mr. Reynolds, you are with the United Mine Workers of America. What do you foresee as the results on labor if the two bills we have been discussing were to pass?

Mr. **Reynolds**. You know, I see a devastating impact to the Midwestern States, and I am talking primarily Indiana, Illinois, Ohio, and western Kentucky. There would be displaced approximately 83,200 UMWA members or mineworkers under either one of these proposed legislations.

Senator **Pressler**. Mr. Meyer, what about your views on that, would that be true in your State?

Mr. **Meyer**. Yes, sir; we have presently close to 6,000 miners out of work, out of a labor force of about 18,000 that are presently employed. We feel that the coal that would be mined would be low sulfur western coal.

Senator **Pressler**. There has been the implication that the Canadians are very interested in increased electricity exchange with the United States at the expense of domestic power producers who burn high sulfur coal.

Do you have a reaction to that question which I asked earlier of the first panel? Do you think the Canadians have an interest beyond just acid rain?

Mr. **Harrison**. I do not wish to presume to know what their strategies are.

Mr. **Meyer**. Senator, I think rather than typify it as I believe you did before a "conspiracy," I would not want to call it an "acid rain conspiracy" but I would say that their national planning on electricity production and export of it is more definite and there is a lot more that goes into it.

Obviously, if you have generation capacity, if you are in a frostier frost belt than we are in the Midwest, that a logical source to export power would be to the United States. If per chance the Ohio River basin powerplants could not function, it would be an economic incentive for them to do it.

Senator **Pressler**. We thank the panel very much.

Mr **Harrison**. Sir, may I just add one other comment? It seems that our industry is so often portrayed as being callous and indifferent to the problem.

I would like to state that we are not assuming that there is no problem or that we are not somehow implicated, but we are trying to take a position that it should not be up to our customers to have to pay the bill for a grand experiment in which there is so much uncertainty.

Senator **Pressler**. On this we have labor and management apparently agreeing.

Mr. **Harrison**. Yes, I believe so. Thank you.

Mr. **Meyer**. Senator, in light of the fact that I did not get through my remarks, may I submit additional written material?

Senator **Pressler**. Yes, you certainly may.

Mr. **Meyer**. Thank you.

Senator **Pressler**. Thank you very much.

We shall now call on our administration witnesses who have come from another hearing this morning. Mr. Thomas M. T. Niles, Deputy Assistant Secretary for European Affairs, Department of State, and the Honorable Kathleen M. Bennett, Assistant Administrator for Air, Noise, and Radiation, Environmental Protection Agency.

Ms. Bennett and Mr. Niles, we thank you for being here. You have had a busy morning.

Ms. **Bennett**. It was a little bit less busy than we anticipated, Mr. Chairman, but I would certainly thank you for your flexibility in accommodating rather unpredictable schedules.

Senator **Pressler**. You may proceed.

Ms. **Bennett**. Mr. Niles actually is going to begin.

Senator **Pressler**. All right. If we can have about 8 minutes. If you need more, tell me. We can put it in the record.

STATEMENT OF THOMAS M. T. NILES, DEPUTY ASSISTANT SECRETARY FOR EUROPEAN AFFAIRS, DEPARTMENT OF STATE

Mr. **Niles**. Thank you very much, Mr. Chairman.

I am Thomas Niles, Deputy Assistant Secretary of State for European Affairs. In that capacity I am the U.S. Chairman of the United States-Canadian Coordinating Committee on Transboundary Air Pollution.

I thought I would use this occasion to report briefly to you on our negotiations to date with the Canadians on the subject of transboundary air pollution, a highly sensitive and important issue in our relations with our close friend and ally to the north.

As you know, the ties between the United States and Canada cover a broad range of cooperative activities, political, economic, cultural, commercial, and defense.

Our relationship with Canada is broader than with any other foreign country. The two governments work closely together, consult regularly on bilateral and international issues. As long-time friends and allies we share the same basic goals.

During his first year in office, President Reagan met five times with Canadian Prime Minister Trudeau, which certainly confirms the important place which Canada occupies in U.S. foreign policy, and the President's personal commitment to and interest in the United States-Canadian relationship.

In the defense sphere we and Canada are close allies in NATO and partners in the defense of North America. The North American Aerospace Defense Command [NORAD] the joint command with a U.S. Commander and a Canadian Deputy Commander, provides for aerospace surveillance, warning of possible attack by bombers or missiles, and air defense. The two Governments are assisted in managing the broad range of defense relations by the Permanent Joint Board on Defense, established in 1940.

United States-Canadian bilateral trade and investment is far and away the largest we have with any foreign country. Two-way trade in 1981 was in the range of $83 billion, and at the end of 1980, U.S. investment in Canada and Canada's investment in the United States totaled $54 billion.

We cooperate very closely with the Canadians in energy. An important step ahead in the energy area was the Congressional action last fall of approving the President's proposal to remove roadblocks to private financing of the Alaska natural gas pipeline, a project which we hope will now be possible under private financing.

We also have very close and intensive relations with the Canadians in the fisheries area. Here the dispute arising from our overlapping boundary claims off the east coast has been submitted to the International Court of Justice in The Hague for binding adjudication.

Finally, turning to the specific subject we are considering today, environmental issues are of great importance in the United States-Canadian relationship.

The United States-Canada International Joint Commission has worked since 1909 on transboundary problems and it continues to monitor and assist in the solution of bilateral pollution issues. The United States and Canada have accomplished a great deal in cleaning up water pollution under the Great Lakes Water Quality Agreement of 1972 and subsequent agreements.

Today, the question of transboundary air pollution is of particular importance to both countries. We approach this problem with an acute awareness of the high level of concern in Canada about acid rain and acidification of lakes, rivers, and streams. We know that many areas in the United States have similar concerns and problems, and indeed we should remember that the original impetus for a bilateral approach on this issue came from the U.S. Congress.

In the fall of 1978, the Congress adopted a resolution calling upon the President, "To make every effort to negotiate a cooperative agreement with the Government of Canada aimed at preserving our mutual airshed so as to protect and enchance air resources and insure the attainment and maintenance of air quality protective of public health and welfare."

As a result of that resolution, informal bilateral discussions with Canada were begun in 1978. We also organized in that same year the bilateral research consultative group.

Discussions with Canada continued in 1979. In July of that year, the United States and Canada issued a joint statement on transboundary air quality, recognizing that both countries contribute to transboundary air pollution and announcing the intention to develop a cooperative agreement on air quality.

As a result of further discussions, the United States and Canada signed a memorandum of intent in August 1980, agreeing on procedures to be followed in preparing for and negotiating an agreement on transboundary air pollution.

The memorandum provided for the creation of a United States-Canada Coordinating Committee and under it five joint work groups composed of United States and Canadian Government representatives from scientific, technical, and legal areas.

The U.S. membership of about 50 is drawn from 8 different Federal agencies. The Canadian membership is comparable. The objective of the United States-Canada work groups has been to develop as much mutual understanding of the causes and effects of transboundary air pollution as possible. The work groups have been hard at work for more than a year now. Their reports are to be ready at the end of March, at which time they will be subjected to peer review and will serve as a technical basis for use in the negotiations.

During his first visit to Canada in March of last year, the President confirmed our commitment to open negotiations on transboundary air pollution, as called for in the memorandum of intent. The President noted U.S. support for the ongoing cooperative scientific work to better understand the problem. He also indicated his expectation that the negotiations would prove lengthy.

Our interest in an agreement with Canada stems from the fact that the only sensible approach to the problem is a cooperative one with our northern neighbor, as the Congress has recognized.

In addition, we want Canada to adopt stricter air pollution control regulation now in effect in the United States. At present, the Canadian Federal Government is generally able only to recommend pollution regulation to the provinces, which have final authority to implement environmental programs.

We would like to see improved emissions control technology applied to Canadian smelters and major powerplants. For instance, there are more than 100 sulfur dioxide scrubbers now in operation or in final stages of construction at powerplants in the United States, while there are no such scrubbers on powerplants in Canada.

Further, U.S. standards for control of automobile emissions are three times stricter than those in Canada. We believe that achieving an equivalent level of pollution control in the two countries should be our mutual objective.

Because of the importance of the issue with Canada, and its complexity, we believe transboundary air pollution can best be addressed in bilateral negotiations, whether we work toward a treaty or an executive agreement. This is a common problem and we believe it requires a joint solution. We would foresee difficulties in concluding an agreement with Canada if either country, or both, were inclined to act unilaterally now.

We held our first two formal negotiating sessions with Canada last year in June and November. These meetings were devoted in part to review of the progress of the work groups and to developing further guidance for their work.

We have also exchanged a series of technical papers and have begun discussions on the nature of an eventual agreement. At our next session, planned for February 24 here in Washington, we expect to begin discussion of the agreement text. I personally believe as the head of the U.S. delegation that the negotiations are going well, and we intend to push ahead as fast as the degree of our scientific understanding of the issue will allow.

I can assure you that we do care about and are concerned about Canadian concerns on air pollution, and that we are indeed committed to working out an agreement mutually acceptable and balanced in its provisions to deal with this problem.

The Canadians have made clear that they believe the two countries should enter into an interim program to control transboundary air pollution.

Sorry, my time is up. Let me just say that this is an area where we should continue the negotiations, continue the scientific work, and hope that as the scientific work is concluded this will give us a good basis on which to conclude an agreement.

Thank you, sir.

[Mr. Niles' prepared statement follows:]

Prepared Statement of Thomas M. T. Niles

I am Thomas Niles, Deputy Assistant Secretary of State for European Affairs. My responsibilities include U.S. relations with Canada. In that capacity I am the U.S. chairman of the United States-Canada Coordinating Committee on Transboundary Air Pollution. Today I would like to present to you a status report on our negotiations with Canada on transboundary air pollution, a highly sensitive issue in our relations with our close friend and ally to the north.

Let me preface my report with a brief discussion of the general state of United States-Canada relations.

As you know, the ties between the United States and Canada extend across a broad range of cooperative activities, in political, economic, cultural, commercial, and defense relations. Our relationship with Canada is broader than that with any other foreign country. The two governments work closely together, and consult regularly on bilateral and international issues. As long time friends and allies, we share the same goals. In his first year in office, President Reagan met five times with Canadian Prime Minister Trudeau, confirmation of Canada's important place in American foreign policy and of the President's personal interest in the United States-Canadian relationship.

The United States and Canada are close allies in NATO and partners in the defense of North America. The North American Aerospace Defense Command (NORAD), a joint command with a U.S. Commander and a Canadian Deputy Commander, provides for aerospace surveillance, warning of possible attack by missiles or bombers, and air defense. The two governments are assisted in managing the broad range of United States-Canada defense relations by the Permanent Joint Board on Defense, established in 1940.

United States-Canada bilateral trade and investment is, far and away, the largest with any foreign country. Two-way trade in 1981 was in the range of $83 billion; at the end of 1980, U.S. investment in Canada and Canada's investment in the United States totaled $54 billion.

Energy is an important area of bilateral cooperation, and the United States and Canada have been working to resolve problems arising in the United States from Canada's National Energy Program. An important step ahead in the energy area was the Congress' action last fall approving the President's proposal to remove roadblocks to private financing of the Alaska natural gas pipeline. We hope it will now be possible for the financial community to arrange for the financing of this vast project, which would benefit both countries.

Fisheries is another sector important to both countries, and here too we are encouraged by an important recent development. The dispute arising from our overlapping boundary claims off the East Coast, covering the rich Georges Bank, has been submitted to the International Court of Justice in The Hague for binding adjudication. Last month the Court constituted a special chamber to hear the case. The Court's decision will go a long way toward resolving our longstanding problems involving fisheries in this area.

Environmental issues are of great importance in the United States-Canadian relationship. The United States-Canada International Joint Commission has worked since 1909 on transboundary problems and it continues to monitor and assist in the solution of bilateral pollution issues. The United States and Canada have accomplished a great deal in cleaning up water pollution under the Great Lakes Water Quality Agreements. Today, the question of transboundary air pollution is of particular importance to both countries. We approach this problem with an acute awareness of the high level of concern in Canada about acid rain and acidification of lakes, rivers and streams. We know that many areas in the United States have similar concerns, and indeed that the original impetus for a bilateral approach on this issue came from the Congress.

In the fall of 1978, the Congress adopted a resolution calling upon the President "to make every effort to negotiate a cooperative agreement with the Government of Canada aimed at preserving our mutual airshed to protect and enhance air resources and insure the attainment and maintenance of air quality protective of public health and welfare." As a result of that resolution, informal bilateral discussions with Canada on air pollution were begun in 1978. Also in 1978, we organized with Canada the Bilateral Research Consultative group. The group, composed of United States and Canadian scientists, carried out preliminary surveys of research on transboundary air pollution and completed useful reports on long range transport of air pollutants in 1979 and 1980.

Discussions with Canada continued in 1979. In July of that year the United States and Canada issued a joint statement on transboundary air quality recognizing that both countries contribute to transboundary air pollution and announcing the intention to develop a cooperative agreement on air quality.

As the result of further discussions, the United States and Canada signed a Memorandum of Intent in August 1980, agreeing on procedures to be followed in preparing for and negotiating an agreement on transboundary air pollution. The Memorandum provided for the creation of a United States-Canada Coordinating Committee, and under it five joint Work Groups composed of United States and Canadian Government representatives from scientific, technical and legal disciplines. The U.S. membership of about 50 is drawn from eight different Federal agencies. The Canadian membership is comparable. The objective of the United States-Canada Work Groups has been to develop as much mutual understanding of the causes and effects of transboundary air pollution as possible. The Work Groups have been hard at work for more than a year now. Their reports are to be ready at the end of March. They will be subjected to peer review and will serve as a technical basis for use in the negotiations.

During his first visit to Canada in March of last year, the President confirmed our commitment to open negotiations on transboundary air pollution, as called for in the Memorandum of Intent. The President noted U.S. support for the ongoing cooperative scientific work to better understand the problem. He also indicated the expectation that the negotiations could be lengthy.

Our interest in an agreement with Canada stems from the fact that the only sensible approach to the problem is a cooperative one with our northern neighbor, as the Congress has recognized. In addition, we want Canada to adopt the stricter air pollution control regulation now in effect in the United States. At present, the Canadian federal government is generally able only to recommend pollution regulation to the provinces, which have final authority to implement environmental programs. We would like to see improved emissions control technology applied to Canadia smelters and major powerplants. For instance, there are more than 100 SO_2 "scrubbers" now in operation at powerplants in the United States or in final stages of construction. There are no scrubbers on powerplants in Canada. Further, U.S. standards for control of automobile emissions are three times stricter than Canadian standards. We believe that achieving an equivalent of pollution control in the two countries should be our mutual objective.

Because of the importance of the issue with Canada, and its complexity, we believe transboundary air pollution can best be addressed in bilateral negotiations, whether we work toward a treaty or an executive agreement. This is a common problem; we believe it requires a joint solution. We would foresee difficulties in concluding an agreement with Canada if either country, or both, were inclined to act unilaterally now.

We held our first two formal negotiating sessions with Canada in June and in November, last year. These meetings were devoted in part to review of the progress of the Work Groups and to developing further guidance for their work. We have also exchanged a series of technical papers and have begun discussions on the nature of an eventual agreement. At our next session, planned for February 24, we expect to begin discussion of the agreement text. I belive the negotiations are going well. We intend to push ahead as fast as the degree of our scientific understanding of the problem will allow.

Canada has made clear it believes the two countries should enter into an interim program to control transboundary air pollution. On the U.S. side, we think it premature to embark upon expensive new control programs now given the uncertainty of the scientific data currently available. It is now generally recognized in both countries that we do not adequately understand the atmospheric chemistry which transforms emissions into acid deposition. There are other significant uncertainties in critical areas of air pollution, including the interactive role of photochemical pollutants, the source-receptor relationships, and the effects of weather and seasonal factors. Importantly, we do not know whether further control actions would produce the desired environmental results.

In the United States, at the request of the President, we began last year to undertake an expanded and accelerated research program to address the key areas of uncertainty on acid rain. The United States will spend over $18 million on comprehensive research in fiscal year 1982, exploring virtually every aspect of the issue. In fiscal year 1983, the figure will be $22.3 million, more than a 20-percent increase in funding.

The United States believes prudence and realism demand a firm foundation of understanding upon which best to determine what measures would be necessary and effective in controlling transboundary air pollution. This is particularly true in view of the enormous cost of existing technical approaches to controls.

In closing, I would like to emphasize again that transboundary air pollution is very much a common problem that will require joint United States-Canadian efforts. We look forward to bringing these negotiations to a successful conclusion. We recognize that there may be no cheap, easy solutions to transboundary air pollution problems. We intend to continue to give this important issue the careful and serious attention it deserves, in the context of our close, friendly relations with Canada.

Senator PRESSLER. Thank you very much. Ms. Bennett?

STATEMENT OF KATHLEEN M. BENNETT, ASSISTANT ADMINISTRATOR FOR AIR, NOISE, AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY

Ms. BENNETT. Thank you, Mr. Chairman, members of the subcommittee. I am Kathleen Bennett, Assistant Administrator for Air, Noise, and Radiation of the U.S. Environmental Protection Agency.

I am pleased to appear before you to discuss the Agency's views on acid deposition. Acid deposition has become an issue of increasing global interest and a matter of concern to both the administration and to the Congress.

The Reagan administration is committed to resolving the issues surrounding acid deposition. President Reagan, in expressing his determination to seek reauthorization of the Clean Air Act and in outlining his 11 principles under which he hopes this revision will occur, called for the acceleration of research on acid deposition.

To accomplish this, the President's budget increased Federal funding for acid rain research by 60 percent, from $11 million in fiscal year 1981 to $18.2 million in fiscal year 1982. He has proposed an additional 22-percent increase to $22.3 million in fiscal year 1982.

"Acid deposition" is a general term for the deposition of acidic materials, whether wet or dry, from the air onto the surface of the Earth or upon structures or objects.

In several areas of North America, acid deposition occurs in varying degrees of severity. However, the circumstances of its formation, the nature of its effects under various conditions, and the feasibility of potential controls are the subject of considerable debate.

Mr. Chairman, in the interest of time I will submit my full statement for the record and omit the discussion of the nature of acidic deposition.

Despite the current knowledge concerning acid deposition, a number of major uncertainties remain to be resolved.

Although oxides of sulfur and nitrogen are considered to be precursors of acid deposition, the transformation processes are not yet understood. While there are significant differences in the composition and acidity of rain between seasons, geographical regions, and even during and between storms, no clear evidence is yet available which can explain or predict accurately how precursors are transformed or why the observed variations occur.

Another uncertainty exists with regard to the transport and distribution of precursor emissions. Remote regions of the globe have rains with a low pH, as do Hawaii and Alaska. To resolve such controversies, better data and more accurate modeling techniques are necessary.

Other uncertainties for which clearer answers are needed include the relative impact of local sources as compared to more distant sources; the role of other photochemical pollutants and how they affect acidity levels; and the relative importance of the potential effects from acid deposition on different receptors, that is, aquatics, forests, materials, and so forth.

The uncertainty surrounding acid deposition is demonstrated by the conclusions reached in two recent studies receiving much attention. While the results of the studies are preliminary and have not yet been subject to peer review, the potentially conflicting results are important to note. One study, conducted by the University of Rhode Island on the long-range transfer of sulfates in the atmosphere, indicates that acid deposition in the Northeastern States may be derived from sulfur dioxide emissions of local origin rather than from the Midwest as is commonly perceived. Preliminary data from receptor points in Massachusetts and Rhode Island suggest that sulfates in the atmosphere contain little trace of the "signature" of sources in the Midwest. Another recent study by the Mitre Corp. concludes that the current acid deposition problem is largely a long-range transport problem and cites recent decreases in SO_2 and NO_x emissions in the Northeast while acidity has increased. These studies, in presenting varying theories on acid deposition, emphasize the seriousness of the current uncertainty and our need for further research.

Any remedial action must be based on a reasonable certainty that it will, in fact, accomplish its intended purpose. The American people have the right to expect that their Government will not impose an additional multibillion-dollar pollution control program, as some have suggested, without first determining with some assurance that the intended environmental benefits will be achieved.

In this case, quick and simple solutions are extremely costly and unlikely. Given the length of time it has taken to recognize the magnitude and complexity of the problem and the many fundamental questions that remain to be answered, Congress wisely authorized a comprehensive research program.

Currently, in an effort to reduce uncertainties so that meaningful and effective program options can be considered, EPA is working on a number of projects. EPA alone has committed more than $9 million in fiscal year 1982 just to its research efforts on acid deposition. The proposed budget for fiscal year 1983 includes $11.4 million for EPA's contribution to Federal acid deposition research efforts.

The three major areas of uncertainty toward which EPA's portion of the research program is directed are: Transport, transformation, and deposition processes; effects of acid deposition; and assessments and policy studies.

Attached to my statement is a summary of the Agency's major research efforts relating to acid deposition. The funding levels are indicated.

In 1980, Congress passed the Acid Precipitation Act. It established an interagency acid precipitation task force to prepare a 10-year comprehensive research plan to identify the causes and effects of acid deposition. Congress directed that annual reports be submitted which "detail the progress of the research program under this subtitle and contain such recommendations as are developed."

The national acid precipitation assessment program began in October 1981, and provided the basis for a broad and comprehensive interagency attempt to examine the many issues relevant to the understanding and addressing of acid deposition. EPA has been designated as the lead agency for three of the research areas: Aquatic effects, control technology, and data assessment analysis.

The 10-year Federal research effort will produce data which will reduce substantially the uncertainties surrounding acid deposition. The results of research from all sources, public and private, are compiled and evaluated in assessments that provide research support for regulatory decisionmaking.

The interagency task force on acid precipitation will release shortly its first annual report to the President and to the Congress. According to a draft version of that report, an initial and indepth critical assessment of the current status of our knowledge and the significance for policy decisions is now underway and is expected to be completed by the end of the year. Next year's annual report, which is scheduled to be published in January 1983, will describe the progress made in the first full year of research as well as the possible policy implications of completed studies.

Within the next 3 to 5 years, we anticipate that many ambiguities and uncertainties will be reduced. Specifically, we expect to have the following information:

Additional studies of historic lake, stream, and reservoir data.

Status reports on acid deposition effects on agricultural crops.

A new report on the role of clouds and storm fronts in forming and scavenging acids in the atmosphere.

The results of pilot tests and a completed demonstration of new combustion processes for controlling oxides of nitrogen and sulfur dioxide at significantly reduced costs.

A summary report on the quantitative impacts of acid deposition on materials.

Additional results from Europe on forest productivity.

A progress report by the National Oceanic and Atmospheric Administration on acid rain in remote locations.

An aquatic model for predicting the rate of acidification occurring in lakes.

Second-generation models for predicting the long-range transport and deposition of sulfur and nitrogen.

Field studies validating laboratory experiments of the effects of acid deposition on selected major crops.

[Ms. Bennett's prepared statement follows:]

PREPARED STATEMENT OF KATHLEEN M. BENNETT

Good morning, Mr. Chairman and members of the Subcommittee. I am Kathleen M. Bennett, Assistant Administrator for Air, Noise, and Radiation of the U.S. Environmental Protection Agency. I am pleased to appear before you to discuss the Agency's views on acid deposition. Acid deposition has become an issue of increasing global interest and a matter of concern to both the Administration and to Congress. The Reagan Administration is committed to resolving the issues surrounding acid deposition. President Reagan, in expressing his determination to seek reauthorization and in outlining 11 principles for Clean Air Act review, called for the acceleration of research on acid deposition. To accomplish this, the President's budget increased Federal funding for acid rain research 60 percent, from $11 million in fiscal year 1981 to $18.2 million in fiscal year 1982, and proposes an additional 22 percent increase to $22.3 million in fiscal year 1983.

ACID DEPOSITION—KNOWLEDGE AND UNCERTAINTIES

"Acid deposition" is a general term for the deposition of acidic materials whether wet or dry, from the air onto the surface of the earth or upon structures, or objects.

In several areas of North America, acid deposition occurs in varying degrees of severity. The circumstances of its formation, however, the nature of its effect under various conditions, and the feasibility of potential controls are the subject of considerable debate.

There is considerable information on some aspects of the emissions of oxides of sulfur and nitrogen which are considered to be the precursors of acid deposition. The majority of man-made emissions of sulfur oxides in the United States comes from utilities; the remainder comes from other combustion sources, non-ferrous smelters, and transportation sources. U.S. nitrogen oxide emissions come mainly from transportation and from utilities and industrial boilers.

Emissions tend to be highly interactive, and multiple emissions must be considered simultaneously. Both sulfur and nitrogen oxides can be transformed into sulfuric and nitrogen acids by reacting with moisture as well as other substances in the atmosphere. These transformations can take place in cloud or rain droplets or after deposition. Depending on a number of variables, emissions may be deposited relatively near their sources or transported over great distances.

Despite the current knowledge concerning acid deposition, a number of major uncertainties in our current thinking remain to be resolved.

In this case, quick and simple solutions are extremely costly and unlikely. Given the length of time it has taken to recognize the magnitude and complexity of the problem and the many fundamental questions that remain to be answered, Congress wisely authorized a comprehensive research program.

One uncertainty has been the pH level at which precipitation should be considered abnormally acidic. The conventional definition is based on pure water saturated with atmospheric carbon dioxide. It has a pH of 5.6, which is, therefore, the theoretical level of "normal" rainfall. Naturally occurring precipitation may be considerably more or less acidic.

Although oxides of sulfur and nitrogen are considered to be precursors of acid deposition, the transformation processes are not yet understood. While there are significant differences in the composition and acidity of rain between seasons, geographical regions, and even during and between storms, no clear evidence is yet available which can explain or predict accurately how precursors are transformed or why the observed variations occur.

Another uncertainty exists with regard to the transport and distribution of precursor emissions. Remote regions of the globe have rains with a low pH, as do Hawaii and Alaska. To resolve such controversies, better data and more accurate modeling techniques are necessary.

Other uncertainties for which clearer answers are needed include the relative impact of local sources as compared to more distant sources; the role of other photochemical pollutants and how they affect acidity levels; and the relative importance of the potential effects from acid deposition on different receptors (i.e., aquatics, forests, materials, etc.)

The uncertainty surrounding acid deposition is demonstrated by the conclusions reached in two recent studies receiving much attention. While the results of the studies are preliminary and have not yet been subject to peer review, the potentially conflicting results are important to note. One study, conducted by the University of Rhode Island on the long-range transfer of sulfates in the atmosphere, indicates that acid deposition in the Northeastern State may be derived from sulfur dioxide emissions of local origin rather than from the Midwest as is commonly perceived. Preliminary data from receptor points in Massachusetts and Rhode Island suggest that sulfates in the atmosphere contain little trace of the "signature" of sources in the Midwest. Another recent study by the Mitre Corporation concludes that the current acid deposition problem is largely a long-range transport problem and cites recent decreases in SO_2 and NO_x emissions in the Northeast while acidity has increased. These studies, in presenting varying theories on acid deposition, emphasize the seriousness of the current uncertainty and the need for further research.

NEED FOR RESPONSIBLE ACTION

Any remedial action must be based on reasonable certainty that it will, in fact, accomplish its intended purpose. The American people have the right to expect that their government will not impose an additional multi-billion dollar pollution control program as some have suggested. without first determining with some assurance that the intended environmental benefits will be achieved.

Currently, in an effort to reduce uncertainties so that meaningful and effective program options can be considered, EPA is working on a number of projects.

EPA alone has committed more than $9 million in fiscal year 1982 just to its research efforts on acid deposition. The proposed budget fiscal year 1983 includes $11.4 million for EPA's contribution to Federal acid deposition research efforts.

The three major areas of uncertainty toward which EPA's portion of the research program is directed are: (1) transport, transformation, and deposition processes; (2) effects of acid deposition; and (3) assessments and policy studies.

Attached to my statement is a summary of the Agency's major research efforts relating to acid deposition. The funding levels are indicated.

OTHER FEDERAL ACID DEPOSITION RESEARCH ACTIVITIES

In 1980, Congress passed the Acid Precipitation Act. It established an interagency Acid Precipitation Task Force to prepare a ten-year comprehensive research plan to identify the causes and effects of acid deposition. Congress directed that annual reports be submitted which "detail the progress of the research program under this subtitle and * * * contain such recommendations as are developed."

The National Acid Precipitation Assessment Program began in October 1981, and provides the basis for a broad and comprehensive interagency attempt to examine the many issues relevant to understanding and addressing acid deposition. EPA has been designated as the "lead agency" for three of the research areas: aquatic effects, control technology, and data assessments and analysis.

The ten-year Federal research effort will produce data which will reduce substantially the uncertainties surrounding acid deposition. The results of research from all sources, public and private, are complied and evaluated in assessments that provide research support for regulatory decision-making.

The Interagency Task Force on Acid Precipitation will release shortly its first Annual Report to the President and the Congress. According to a draft version of that report, an initial and in-depth critical assessment of the current status of our knowledge and the significance for policy decisions is now underway and is expected to be completed by the end of the year. Next year's Annual Report, which is scheduled to be published in January 1983, will describe the progress made in the first full year of research as well as the possible policy implications of completed studies.

ANTICIPATED RESEARCH RESULTS

Within the next three to five years, we anticipate that many ambiguities and uncertainties will be reduced. Specifically, we expect to have the flowing information: Additional studies of historical lake, stream, and reservoir data. Status reports on acid deposition effects on agricultural crops. A new report on the role of clouds and storm fronts in forming and scavenging acids in the atmosphere. The results of pilot tests and a completed demonstration of new combustion processes for controlling oxides of nitrogen and sulfur dioxide at significantly reduced costs. A summary report on the quantitative impacts of acid deposition on materials. Additional results from Europe on forest productivity. A progress report by the National Oceanic and Atmospheric Administration on acid rain in remote locations. An aquatic model for predicting the rate of acidification occurring in lakes. Second-generation models for predicting the long-range transport and deposition of sulfur and nitrogen. Field studies validating laboratory experiments of the effects of acid deposition on selected major crops.

GLOBAL TRANSBOUNDARY AIR POLLUTION ACTIVITIES

Because transboundary air pollution is increasingly a global concern, the United States signed an instrument accepting the United Nations Economic Commission for Europe Transboundary Air Pollution Convention on November 5, 1981. Moreover, with the August 5, 1980, Memorandum of Intent on Transboundary Air Pollution, Canada and the United States agreed to begin cooperative steps to deal with transboundary air pollution and to develop a bilateral agreement. Formal negotiations were held in June and November of 1981 and another meeting is scheduled to be held here in Washington on February 24, 1982.

Within this structure, Work Groups are reviewing and evaluating currently available information. The Work Groups are comprised of representatives from EPA; the Departments of State, Agriculture, Interior, and Energy; the Council on Environmental Quality, the National Oceanic and Atmospheric Administration; and other agencies as well as representatives from corresponding Canadian departments. EPA is actively involved in directing the efforts of many of these Work Groups. I chair the Work Group which is investigating Strategies Development and Implementation. Kurt Riegel of EPA's Office of Research and Development chairs the Work Group on Emissions, Costs and Engineering. EPA representatives serve as vice chairs of the Work Groups which address Impact Assessment and Atmospheric Sciences and Analyses. Interim Work Group reports are currently being reviewed. Technical reports are due to be completed by the end of March. Before being transmitted to the representatives involved in the negotiations, the reports will undergo peer review which will be arranged by the Science Advisor to the President.

SUMMARY

Acid deposition is a concern of many Americans, one shared by the Congress and by the Administration. The depth of this concern should be reflected in public policies that are based on sound science.

As we have indicated there are major uncertainties in many critical areas, particularly the transport and transformation of possible precursor emissions, the effects of acid deposition, and the policy implications of controlling acid deposition. The enactment of the Acid Precipitation Act of 1980 by the Congress established a comprehensive intergovernmental and interdepartmental research plan so that the complexities of acid deposition could be more fully addressed.

Without such a firm foundation on which to base our decisions on whether controls are necessary, in what areas and to what degree, any regulatory action at this time would involve substantial guesswork.

Because of the many fundamental scientific uncertainties and the possible substantial cost burden of additional controls; and given extensive Congressional involvement, including the ten-year directive to investigate the problem and the fact that current research is expected to provide us with better data and guidance, we look forward to fulfilling the perceptive, realistic, and multi-disciplined approach of Congress, as embodied 20 months ago in Title VII of the Energy Security Act.

Additionally, we hope that useful results will continue to be realized from our mutual effort with Canada.

This concludes my prepared statement. I would be happy to respond to any questions you may have.

[Attachment]

MAJOR EPA RESEARCH ON ACID DEPOSITION

To reduce uncertainty in the area of transport, transformation and deposition processes, we are studying the following:

$800,000 for research on consolidating and reconciling current oxides of sulfur and nitrogen emissions information. This will create a data base that can be used to show a more accurate pattern of the magnitude and geographic distribution of man-made sources of these pollutants. We will be able then to improve our predictive capabilities, particularly with regard to major emissions sources.

$800,000 for systematic data collection and monitoring studies of deposition and for associated research to increase the data on trends in deposition, and to improve monitoring techniques for both wet and dry acid deposition.

$3,100,000 for atmospheric process research to obtain a better understanding of the actual mechanics of atmospheric transport, transformation, and deposition.

In order to gain a fuller understanding of the effects which may result from acid deposition, our efforts include:

$100,000 for health effects impact studies on the effect of acid deposition on drinking water supplies, surface water, and groundwaters.

$250,000 on materials research to determine the portion of material corrosion attributable to acid deposition rather than to ambient air pollutants or other sources. This will also investigate the extent and aggregate cost of such damages.

$1,400,000 for aquatic research to estimate the total number of lakes affected by acid deposition, as well as the sensitivity of streams and lakes to acidification, and the rate at which acidification actually occurs. In addition, these water quality measurements must be integrated with improved data on the impact of acid deposition on fish and the food chain, in order to develop information for possible short-term and long-term preventive and restorative measures.

$1,300,000 for terrestrial studies of acid impacts on forest soils and trees, on soil nutrients, on leaching processes, and on soil chemistry changes. Both laboratory and field studies of acid deposition impacts on agriculture and major U.S. crops are also scheduled.

We are taking a broad look at possible policies and strategies, and their implications:

$1,300,000 for assessments and policy studies which will identify possible research avenues leading to potential mitigation strategies. Those options will then be analyzed considering the weight of existing scientific knowledge, costs and benefits, geography, degree of effectiveness, and other factors.

Senator **PRESSLER**. Ms. Bennett, I am going to have to interrupt. The bell has rung for a vote on the Senate floor.

I have a series of questions from myself and from Senator Dodd. I can wait until the second bells and still make the vote. But I could ask each of you two or three questions and then submit the rest in writing because it will be 15 or 20 minutes before I get back.

So, unless you object, we can submit the rest of your statement for the record and I can ask you each a couple of questions here before the next bells ring.

Let me first thank you both for being here.

This question involves the memorandum of intent with Canada. In an effort to take interim action in accordance with the 1980 memorandum of intent, Canada's Federal Government has prevailed upon Ontario to take steps to reduce emissions at INCO's Sudbury smelter and Ontario Hydro's power facilities.

In addition to this action, the Canadian Parliament has enacted legislation to provide the Federal Government with the authority to control transboundary pollution originating in Canada. Has the United States taken any comparable interim measures?

Mr. **NILES**. Mr. Chairman, first as regards the Canadian actions. It is correct that in 1980 Canada amended its Clean Air Act, this was in December, to give it a reciprocal provision similar to the provision currently in the U.S. Clean Air Act.

In September 1980 and January 1981, the Province of Ontario announced plans for reductions by the Sudbury smelter which belongs to the International Nickel Co., to begin in June 1983, and also reductions involving Ontario Hydro to begin in 1985.

In addition, we understand that Ontario hydro is considering installing scrubbers on its major powerplants.

We are pleased with these decisions, we regard them as important and significant steps by Canada and by the Provincial Government in Ontario, and we hope these kinds of steps will be taken Canada-wide.

I would say, however, that we would not characterize them as putting Canada in front of the United States as far as pollution control is concerned, but rather as bringing Canada up approximately to where we now stand.

Ms. Bennett can speak more to the question of actions taken by the Environmental Protection Agency during the negotiations. The Canadians have from time to time raised questions regarding specific actions taken by EPA, and I think we have responded to these questions to the satisfaction of our Canadian friends.

Ms. **Bennett**. Mr. Chairman, since 1970, of course, the United States has had quite a stringent clean air law. In fact, it is probably the most stringent clean air law in the world.

This has resulted, among other things, in reductions of ambient levels of sulfur dioxide by approximately 40 percent, and in a reduction of emissions of sulfur dioxide by 12 percent. It is also worth observing that today in the United States there are 87 scrubbers in place with another 32 under construction. There are none in Canada.

So, I believe, we have made a very aggressive effort in this area. We are pleased to see the Canadians now making strides to put a similar kind of structure in place.

Senator **Pressler**. This is a question from Senator Dodd to Ms. Bennett. The administration position, as I understand it, is that further research is needed before we can ascertain if any additional measures should be taken to address the acid precipitation problem.

What finding, Ms. Bennett, would the administration consider sufficient to justify a statutory requirement that sulfur dioxide and nitrogen oxide emissions, the chief suspected precursors of acid precipitation, be substantially reduced, as proposed in the Mitchell or Moynihan bills?

Ms. **Bennett**. Mr. Chairman, my testimony went into some detail concerning current knowledge, the areas that we are studying in an attempt to reduce the uncertainty surrounding the present controversy, and finally the areas of research where we expect to have answers over the next couple of years.

While we do not have to wait until we know everything that there is to know about acid deposition, certainly, we need to know more than we know now, particularly in light of the fact that we do have quite an aggressive Clean Air Act already in place.

The question is, what need we know in order to go beyond the current regulatory structure.

We need to know more about the pollutants of concern and the nature of the transformation process. We have to have some more reliable method of predicting what effects could actually be obtained and what benefits could be obtained by reductions at various locations.

We need to identify exactly the acid deposition problem. Then we would be able to determine whether further regulatory control measures might be required.

Senator **Pressler**. Some of the testimony this morning implied that Canada was doing more than we are on this problem.

I was interested in your remarks. Are the Canadians doing as much—what is your relative judgment there in terms of this problem?

Ms. **Bennett**. In terms of the problem, sir, or in terms of the negotiation?

Senator **Pressler**. In terms of the problem and the negotiations.

Ms. **Bennett**. Well, in either case, we are working quite closely together and both sides are working very vigorously to resolve this problem.

As you know, under the auspices of the negotiation, a number of work groups have been formed. Mr. Niles' testimony identified the fact that perhaps 50 people on both sides are actively engaged in the effort of the work group which has compiled all of the information that pertains to this.

You will find quite an energetic effort underway on both sides of the border to get at the root of the problem and to develop an approach that would ameliorate these concerns.

Mr. **Niles**. I might just say, Mr. Chairman, we certainly do not want to get into the type of discussion with Canada where we say that, well, they are not doing enough, we are doing more than they are doing; sort of mutual recriminations.

This has been so far a very cooperative venture and, as I pointed out in my statement, the only kind of solution to the problem which makes any sense at all is a cooperative solution which is acceptable to both sides.

Certainly, our experience in the two negotiating sessions so far has been that we do have a good atmosphere, a good working relationship with our Canadian friends and one which, I think, will lead us eventually to the conclusion of an agreement.

Senator **Pressler**. I have just been told I have 5 minutes left to vote. I will submit additional questions to you for the record.

Also, I submit to you some questions from Senator Dodd.

[Senator Dodd's prepared statement follows:]

PREPARED STATEMENT OF HON. CHRISTOPHER J. DODD

Mr. Chairman, I appreciate this opportunity to address the issue of acid rain in this Committee and commend you for calling this hearing. While the principle legislation affecting transboundary air pollution problems comes under the jurisdiction of the Committee on Environment and Public Works, it is not only appropriate, but I think imperative, that the Committee on Foreign Relations keep itself and the Congress informed on international implications and ramifications of the acid rain problem.

Because of the importance of this issue to my state of Connecticut and to all of New England, I have actively supported efforts in the Committee on Environment and Public Works to enact legislation designed to reduce the threat of acid precipitation. I testified before that Committee last October 29, on several matters under consideration in the pending Clean Air Act revisions. I ask that a copy of my remarks on acid rain, presented at that hearing, be included in this hearing record following my statement.

I have several questions I would like to submit to Mr. Thomas Hile from the State Department and Ms. Kathleen Bennett from the Environment Protection Agency. At this point I would simply like to express my view that the acid rain issue cannot be addressed as strictly a matter of domestic policy. It is, and will continue to be, a matter involving international relations.

Wishing it away will not make it go away. Ignoring it will not solve it. A domestic political victory by those who do not believe that acid rain is a significant problem or who believe we need to know more before starting to take action will serve to heighten international tensions between this country and the people of Canada.

I believe, as I stated to the Committee on Environment and Public Works, that measures to start correcting the acid rain problem are justified by domestic considerations alone. But the fact that one of our closest neighbors and allies, Canada, considers acid rain to be its number one environmental problem adds substantially to the need for prompt actions.

Finally, I would like to commend again the Senator from Maine, Mr. Mitchell, and the Senator from New York, Mr. Moynihan, for the leadership they have provided in this crucial matter of both domestic and international importance.

[Excerpt from testimony by Senator Chris Dodd, before the Committee on Environment and Public Works, U.S. Senate, October 29, 1981]

ACID RAIN

A related, and perhaps even more difficult, long-range transport problem identified by the Air Quality Commission is that of acid rain. The current Clean Air Act simply does not address the acid rain problem. Again, the focus on local ambient air pollution concentrations ignores the long-term and cumulative effects of widespread atmospheric pollution. In the case of acid rain, the problem is compounded by the tremendous distances over which pollutants often travel and the fact that several chemical transformations occur in the process of long-range transport of these pollutants.

While there remain many uncertainties surrounding the causes and effects of acid rain, the evidence we do have is cause for serious concern, particularly in New England and several other vulnerable regions of the country.

In addition, the Canadian government regards acid deposition as its most critical environmental problem. A recent memorandum of intent between the United States and Canada commits both countries to efforts to reduce the potential for transboundary pollution. Strengthening the Clean Air Act this year is essential to our meeting this international commitment.

The problem of acid rain is not, as some argue, purely hypothetical. Substantial evidence exists that acid deposition, both in rain and dry deposition through gases and particulate matter, has resulted in the disappearance of fish from up to 200 high altitude lakes in the Adirondack area of New York. Similar evidence exists with regard to thousands of fishless lakes in the Canadian Province of Ontario and in Sweden. Several thousand lakes in Minnesota and Wisconsin and additional 48,000 lakes in Ontario alone are considered susceptible to increased acid levels.

Evidence is also mounting that acid rain damages the productivity of soils, affecting both crop yields and forest growth while research has indicated that there are at times positive effects on crop and forest growth from higher levels of sulfur, nitrates and ammonia in precipitation, the opposite is true in sensitive areas where soils are not well buffered by acid neutralizing elements.

The sensitive regions in North America include New England, parts of New York, large areas of Ontario, Quebec, and the maritime provinces of Canada, northern Minnesota, Wisconsin, and Michigan, most of Washington, Oregon and Idaho, and parts of the Appalachia region, Florida, California, Colorado, Montana, Wyoming, Nevada and Missouri.

Acid deposition has been shown to increase the rate of leaching from soils of numerous heavy metals, some of which, in heavier concentrations than normal are toxic to both aquatic life and plants. Heavier toxic metals leaching into water supplies may also pose human health threats.

Acid deposition has also been linked to damage of building materials, creating not only substantial economic losses through more frequent repairs, but also endangering many of the nation's historic buildings and monuments, many of which lie in the northeast where the greatest amount of acid deposition takes place. Increased corrosion of copper water piping and of lead soldered joints has also been shown to result from more acidic water supplies.

In spite of the many unknowns regarding acid rain, its formation has been firmly linked to levels of sulfur dioxide and nitrogen oxides in the atmosphere.

We also know that 90 to 95 percent of the sulfur emissions in eastern North America are from man-made sources.

The Air Quality Commission determined that the problem of acid deposition is severe enough and that enough is known to recommend that the Congress require a significant reduction, by 1990, in the level of sulfur dioxide emissions in the eastern United States. A substantial reduction in sulfur dioxide emissions in the east is particularly important in light of the fact that, under present control technologies, nitrogen oxide emissions are projected to continue to increase during the next decade.

Connecticut, like other New England states and eastern Canada, is at the end of the pollution pipeline in this country. Our problems with acid rain and the long-range transport of air pollution are perhaps more severe than other sections of the country. I believe it is clear, however, that no state is immune from these problems. It is also clear that the more we learn about them, the more severe the consequences appear.

I urge the Committee to address this common problem substantively as we proceed with the Clean Air Act Amendments of 1981. Further research is needed and at an accelerated pace. But our current knowledge as well as our commitments to Canada provide a sound basis for further actions to reduce sulfur dioxide emissions, particularly in the eastern half of the United States.

I believe the Acid Deposition Control Act, S. 1706, recently introduced by Senator Mitchell, me and others provides a sound basis for addressing the problems of acid deposition and urge the Committee to adopt this proposal as an amendment to the Clean Air Act.

Many of the identified effects of acid rain are irreversible. Delay in addressing the principle known causes of this phenomenon would subject the people and the resources of vulnerable areas to totally unacceptable risks.

CONCLUSION

When the hazards of environmental degredation broke upon the American consciousness nearly two decades ago, public confidence in government's commitment to protecting the general welfare was dealt a severe blow. For more than a decade the Clean Air Act has been a keystone in the effort to restore public confidence in government as the servant of the people rather than the servant of narrow special interests. If this Congress shrinks from its responsibility to preserve and enhance public health and general environmental quality, it will rightly be condemned for its gross breach of trust. The Clean Air Act remains a keystone in the effort to restore public confidence in government. I am confident that the American people will not passively tolerate either a Congressional or an administrative dismantling of this vital legislation.

One further matter I would like to address briefly is the assertion raised by some opponents of efforts to control acid rain that the acid rain issue was manufactured by the Canadians to distract attention from other domestic problems or as a means of fueling anti-American sentiment in Canada. Every member of this Committee should know that the acid rain problem was first raised in Canada by Mr. John Fraser when he was the Minister of Environment under the conservative government of Joe Clark. In addition, Mr. Fraser and representatives of the other two major political parties in Canada have made it clear that the government's policy on acid rain will not change no matter what party is in power. Finally on this point, my support for an acid rain control program, and I am sure the support of Senator Mitchell, Senator Moynihan and all other sponsors and cosponsors of acid rain legislation derives principally from the fact that acid deposition is a problem in Connecticut, in Maine, in New York, in Vermont and in numerous other states of this nation. The fact that it is also a problem, and a serious one, for Canada and its provinces only adds impetus to the need to control the problem. We are not doing Canada a favor nor yielding to blackmail by proposing these measures. We are attempting to protect our own people and our own states' resources.

[Additional questions and answers follow:]

State Department's Responses to Additional Questions Submitted by Senator Pressler

STATUS OF KNOWLEDGE CONCERNING THE PROBLEM

Question 1. What do we know about the environmental impacts of acid precipitation on (a) lakes, streams, and aquatic life; (b) terrestrial ecosystems, forests, crops, and soil; (c) man-made materials (buildings, statuary, metals, and surface finishes); and (d) human health?

Answer. While there is much that we presently do not know about acid deposition, we do have data which indicates that certain effects arise due to elevated levels of acidity in precipitation.

We know that certain lakes and streams have experienced an increase in levels of measured acidity. A number of such water bodies have shown corresponding changes in the quality and quantity of naturally occurring aquatic life. Because impacts have varied with geographic location and geological characteristics, it is not now possible to predict future aquatic effects with certainty.

Likewise, airborne acidity may affect terrestrial ecosystems, including forests, crops, and soils. Observed impacts have been both beneficial and harmful. Most observed effects on crops and vegetation have been of a foliar nature and have not been of major significance to the life cycle or productivity of any particular crop or type of vegetation. Effects on forests are uncertain at this time.

Acid deposition is suspected to be a cause of some deterioration of certain man-made building and product materials (e.g. marble and limestone). However, natural weathering and oxidation processes also lead to the deterioration of such materials. To date, research results have not successfully isolated what contribution to observed deterioration arises due to the man-made acid deposition.

Little is known about the effect of acid deposition on human health. Some studies have indicated that there may be an effect on drinking water supplies due to the leaching out of certain metals from pipes. To date, very few studies have been conducted in this area which, like the others, requires much more scientific research.

Question 2. What do we know about the causes of acid rain?

Answer. We would refer you to the section of Mrs. Bennett's prepared statement entitled "Acid Deposition—Knowledge and Uncertainties." In that section, what we know about the causes of acid deposition is discussed along with the areas currently marked by significant uncertainty.

Question 3. Are the current regulations of emissions under the Clean Air Act sufficient to address acid precipitation concerns, given our current state of knowledge about the phenomenon?

Answer. As noted in Mrs. Bennett's prepared statement, our current knowledge about acid precipitation is not sufficient to justify any regulatory control program designed solely to address the problem of acid precipitation. However, both Federal and State regulations issued under the Clean Air Act authority require extensive control of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), both believed to be precursors of acid precipitation. For example, new source performance standards for utility power plants establish stringent emission limitations for both SO_2 and NO_x from new and modified power plants.

The stringency of these standards are reflected by the fact that while coal use in the utility sector is expected to more than double by the year 2000, SO_2 emissions from the utility sector are expected to remain virtually constant.

In addition, SO_2 and NO_x emissions from existing sources are controlled primarily through State implementation plans. These plan requirements are designed to ensure that national ambient air quality standards for these pollutants are attained.

Question 4. How effective would additional proposed regulatory strategies be in alleviating acid precipitation, and what would their economic, environmental and other impacts be?

Answer. The prime focus of our current effort is to determine as quickly as possible reliable research data which can serve as the basis for any future regulatory decisions. The few regulatory studies done to date have focused on the control costs of various options. Almost nothing is known about the environmental benefits of regulatory options, beyond the amount of emissions controlled. This uncertainty makes evaluating the effectiveness of proposed regulatory strategies extremely difficult at present.

Since the passage of the Clean Air Act of 1970, it is estimated that the United States has spent approximately $150 billion on air pollution control. Those expenditures have been driven by our attempts to meet the health and welfare requirements of the Act. We estimate that the approaches proposed in bills currently under consideration would require control costs of approximately $300-$450 per ton of SO_2 emissions reduced per year. EPA has undertaken a detailed review of specific Senate bills and will have that analysis available in the near future.

STATUS OF COMMITMENT TO NEGOTIATE AIR QUALITY AGREEMENT

Question 5. In an effort to take interim action in accordance with the 1980 Memorandum of Intent, Canada's federal government has prevailed upon Ontario to take steps to reduce emissions at INCO's Sudbury smelter and Ontario Hydro's power facilities. In addition to this action, the Canadian Parliament has enacted legislation to provide the federal government with the authority to control transboundary pollution originating in Canada. Has the United States taken any comparable interim measures?

Answer. The United States Government continues to make significant strides in the control of SO_2 emissions. From 1976 to 1980, the SO_2 emissions of utilities in our 10 largest emitting States have dropped by nearly 1.5 million tons per year. That cutback substantially exceeds the projected emissions reductions at INCO and Ontario Hydro by over 1.0 million tons per year. The Tennessee Valley Authority consent decree alone, effective in December of 1980 after the signing of the MOI with Canada, is projected to reduce SO_2 emissions by 1.3 million tons per year by the end of a 6-year period (1978-83).

With regard to the legislation enacted by Canada concerning transboundary air pollution, it should be remembered that the new legislation only mirrors the legislation adopted in the United States in 1977 with the passage of Section 115 of the Clean Air Act.

Question 6. Will the Canadian interim measures bring their emission standards, both provincial and federal, to a level comparable to the U.S. standard? If not, could you provide the Committee with a comparison of the difference?

Answer. Because of the multitude of plant specific standards both here and in Canada, an adequate comparison of United States and Canadian emissions standards is not possible at this time. Such a comparison is also complicated by the fact that the legislative authority behind pollution abatement regulations is different in the two countries. However, we are seeking to clarify these differences in our discussions with the Canadians.

Viewed with these caveats in mind, the following comparisons can be made:

(a) Automotive emissions standards in Canada are three times higher than those in the United States.

(b) SO_2 emissions rates from coal-fired power plants in Canada and the United States are about equal.

(c) On a ton of SO_2 per unit of metal produced, Canadian smelters emit about twice as much as those in the United States.

(d) Less than 3 percent of all counties in the United States are non-attainment for SO_2. In Canada about 98 percent of all SO_2 monitors show compliance with the Canadian Federal ambient SO_2 objective. This would imply comparable compliance status.

(e) On a per capita basis the United States emits about one-third less NO_x and SO_2 than does Canada.

Question 7. What is the status of the Federal research being done on this issue? How much money has been allocated for this research in the fiscal year 1983 budget?

Answer. The President has called for the acceleration of research on acid deposition. To accomplish this, the President's budget increased Federal funding for acid deposition research 40 percent, from $13 million in fiscal year 1981 to $18.2 million in fiscal year 1982, and proposes an additional 22 percent increase to $22.3 million in fiscal year 1983.

We would refer you also to the comments in Mrs. Bennett's prepared statement, especially the sections on "Need for Responsible Action" and "Other Federal Acid Deposition Research Activities."

Question 8. Shouldn't the negotiations and the Clean Air Act revisions move on parallel tracks? What advantage, if any, is gained by moving first on the Clean Air revisions and then the bilateral agreement?

Answer. The process of amendment of the Clean Air Act, while not directly linked to the United States-Canada transboundary air pollution negotiations that began in June 1981, is nonetheless clearly relevant to those negotiations. The Clean Air Act reauthorization process is a domestic matter, but we recognize that there are international overtones. Of course, decisions made in the national context might very well influence the Canadian position in the negotiations. If the revised Clean Air Act does not include sufficient authority to address acid precipitation in a bilateral agreement or treaty, the Administration can request addition authority as needed.

Question 9. The Canadians contend that, while research is needed, enough is now known about acid rain to warrant significant reductions in the emissions of sulphur dioxide and nitrogen oxide. What is your response to this point of view?

Answer. The Canadian Government and the U.S. Government are cooperating under the Memorandum of Intent to address the acid deposition problem. We believe we are meeting the intent and requirements of the MOI. In the United States view, although a scientific data base is available, uncertainty in the data does not now allow us to institute additional and effective controls that may be necessary to protect impacted areas. We are earnestly working to achieve the understanding we need as quickly as possible.

Question 10. Why has there been a failure to meet the timetable for reports from the technical working groups set up under the Memorandum of Intent?

Answer. The initial deadline set under the Memorandum of Intent for completion of technical reports by the Work Groups was January 1982. By the joint agreement of United States and Canadian representatives, that date was changed to March 31, 1982. The due date was extended in response to the need expressed by scientists from both countries for additional time to complete the reports. The scientific work groups (1, 2, and 3B) are completing their reports, but final drafting of some sections and the subsequent production and translation into French will delay the release of these reports.

Question 11. Does the Administration envision, as the end result of negotiation, an Agreement (or Treaty) committing both the United States and Canada to reduce emissions? What is the timetable for such an agreement? How do the Administration's goals differ from those of Canada?

Answer. It is certainly the position of Canada that the agreement result in a program of reduction of emissions. As noted, we believe more knowledge is needed before we can determine the proper scope of an agreement. In addition, a judgment as to whether an executive agreement or treaty would be a more appropriate vehicle has not yet been made. However, given the importance of the issue, our inclination at this point is toward a treaty. It has been our position that a period of two or more years would be required to complete negotiations. While we look to the Great Lakes Water Quality Agreement, which took 3 years to negotiate, as an example of the present negotiations in terms of scale, in fact air pollution is a much larger issue. We believe the goals of the United States and Canada are quite similar. We want to deal with the air pollution problem effectively. We would like to see a balanced and equitable level of pollution control in the two countries.

INCONSISTENT U.S. POSITION

Question 12. Does the Administration plan to relax the nitrogen oxide emission standards for automobiles so that twice the emissions permitted under the 1981 requirements would be allowed?

Answer. The Administration supports H.R. 5252, which calls for a 2.0 gpm NO_x standard for automobiles, twice the current 1.0 gpm standard. However, this relaxation will cause little if any increased acid deposition in Canada. A memo explaining the basis for this opinion is attached.

Question 13. Has the Administration proposed a relaxation of the emission standards required of new power plants?

Answer. No. The Administration strongly supports the existing New Source Performance Standards (NSPS) for coal-fired power plants. However, we also believe that utilities should be allowed to meet those standards in the most efficient and cost-effective way. They should be allowed to do so through coal washing or burning low-sulfur coal, and not be required to apply particular control technologies like scrubbers.

Question 14. Is the Administration prepared to press the utility industry to further reduce their use of high sulfur coal?

Answer. The Administration believes that both industrial and utility coal users should be allowed to meet uniform emission standards in the most cost-effective manner. Utilities and industrial firms should be allowed to determine the most efficient combination of fuel used and control technologies. The principal test is whether any existing source complies with emission limitations necessary to protect national ambient air quality standards and whether new and modified sources comply with applicable requirements.

Question 15. Is the Administration's position on the revisions of the Clean Air Act consistent with the Memorandum of Intent entered into with Canada in 1980 which commits the United States to negotiate an agreement on the control of transboundary pollutants?

Answer. Yes. We believe the Clean Air Act revisions proposed in H.R. 5252, which the Administration supports, would not cause significant increases in air pollutants transported into Canada.

POSSIBLE CONTROL STRATEGIES

Question 16. In view of the country's need to reduce its dependence on foreign oil, it appears necessary to use much greater quantities of coal in the near and intermediate term. If this is so, to what degree should pollution controls be required?

Answer. The current Clean Air Act requires a degree of pollution control necessary to protect public health with an adequate margin of safety. It also requires controls adequate to protect against adverse welfare effects. No matter how much coal is burned to reduce U.S. dependence on foreign oil, pollution controls adequate to protect public health and welfare will be required.

Question 17. Is it necessary to impose stringent federally-mandated emission standards on existing (and converting) coal-fired power plants similar to those already in place for new sources?

Answer. Based on what is known now, no controls beyond those already required for power plant conversions should be imposed.

Question 18. If so, what will this cost and how should these costs be borne?

Answer. EPA analysis shows that SO_2 controls generally cost from $300 to as high as $450 per ton of SO_2 removed per year. In general, pollution control costs are borne by the consumer.

Question 19. If these costs are too prohibitive or if the technology proves to be unavailable, what other resources are available?

Answer. The Federal Government would not impose control costs that were prohibitive, nor mandate a control technology that was unavailable.

Question 20. Does the nuclear option need reexamination?

Answer. If the market is left to operate smoothly, utilities will choose the most cost-effective method of generating electricity. Nuclear power will continue to be an option.

Question 21. What are the various regulatory control strategies now being considered by the Administration to deal with acid precipitation? How do these strategies differ with respect to their costs, energy implications, and ability to reduce emissions?

Answer. We would refer you to the response to question four in the section "Status of Knowledge Concerning the Problem."

U.S. Environmental Protection Agency,
Office of Air Quality Planning and Standards,
Research Triangle Park, N.C., October 5, 1981.

Hon. Henry A. Waxman,
Chairman, Subcommittee on Health and the Environment, Committee on Energy and Commerce, House of Representatives, Washington, D.C.

Dear Mr. Chairman: During the recent hearing on proposed changes to the emission standards for automobiles, you asked what impact relaxing the nitrogen oxide (NO_x) emission standards from 1.0 to 2.0 gpm for automobiles might have on the acid deposition problem. As you may recall, I indicated that I believed there would be little or no impact from the increase in question. The purpose of this letter is to follow up on that statement and clarify the basis for my opinion. My comments were made in the context of the mobile source discussions and were not intended to reach questions related to the significance of stationary sources of NO_x.

There are several reasons to believe that the impact on acid rain of increased emission associated with the proposed adjustment would probably be small. These reasons include:

(1) the difference in total NO_x emissions between the two standards will be a small portion of the total atmospheric loading of precursor emissions to acid deposition in the future years;

(2) on an equivalent mass basis, NO_x emission have the potential to cause about one-half the acid deposition as do sulfur oxide emissions;

(3) NO_x emissions from automobiles are emitted over broad geographical areas and at essentially ground level, thus reducing the potential for long-range transport; and

(4) there is evidence that the interaction between plants and nitrates deposited on the soil may reduce the role of such nitrates in acidifying soils and aquatic systems.

Listed below are the estimated emissions of NO_x and SO_2 for 1979 along with projected levels of these emissions for the year 1995. For NO_x, separate projections are given for a 1.0 and a 2.0 gram/mile emission standard for automobiles.

1979

	Million metric tons
Nitrogen oxides:	
Passenger cars	4
Trucks and other mobile sources	6
Stationary	13
Total	23
Sulfur oxides: All sources	25

1995

(*Case 1*: 2.0 grs/mile std.)

	Million metric tons
Nitrogen oxides:	
Passenger cars	3
Trucks and other mobile sources	6
Stationary	22
Total	31
Sulfur oxides: All sources	26

(*Case 2*: *1.0 grs/mile std.*)

Nitrogen oxides:	
Passenger cars	2
Trucks and other mobile sources	6
Stationary	22
Total	30

It can be seen that in 1979 automobiles (passenger cars) accounted for about 15 percent of the total NO_x emissions and about 7 percent of the total atmospheric loading of nitrogen and sulfur oxides ($NO_x + SO_2$). However, atmospheric emissions of SO_2 tend to form sulfuric acid ($H_2 SO$) which contains 2 hydrogen atoms, while NO_x emissions tend to form nitric acid (HNO_3) which contains one hydrogen atom. Thus, SO_2 emitted into the air has the potential to cause about twice the amount of hydrogen ion deposition as an equal mass of NO_x emission. The deposition process, of course, is not quite that simple, but given that all other things were equal, then in 1979 NO_x emissions from automobiles could have accounted for a maximum of about 5 percent of the total acid deposition: i.e.,

$$\text{Contribution} = \frac{NO_x \text{ car}}{2SO_2 + NO_x \text{ Total}} \times 100$$

Referring to the projections above, it can be seen that in 1995 the difference in total NO_x emissions between 1.0 and 2.0 gram/mile standard is projected to be less than 1,000,000 metric tons. Using the above calculation procedure, this difference is projected to represent only about 1 percent of the total precursor emissions.

The potential impact of increased emissions between the two standards is probably even smaller than 1 percent, for several reasons. Automobiles emit NO_x near ground level, and over large geographic areas. Thus, these emissions are less prone to be transported over great distances than are emissions from very tall stacks.

Further, nitrates in the atmosphere seem to pose less of a threat to aquatic and terrestrial systems than do sulfates in the atmosphere. As I indicated in the hearing, scientific opinion both inside and outside the Agency on the relative significance of NO_x emissions for acid rain has been shifting over the past several years. For example, until recently, it was generally believed that nitrate deposition played a more significant role in the acidification of lakes and other aquatic systems. However, as recently reported by the National Research Council, some scientists now believe that the impact of nitrate deposition on the acidification of aquatic systems may be less than previously thought. An explanation for this is that plants will absorb nitrates deposited on the soil and in the process give off an OH ion. The OH ions will combine with hydrogen ions and reduce the soil acidity. Thus, the leaching of metals and other acid materials from soils into streams, rivers, and lakes may not be as strongly influenced by the deposition of nitrates as was previously thought to be the case.

The above reasons suggest that relaxing the NO_x emission standard for automobiles to 2.0 gram/mile will not contribute significantly to acid deposition. This appears to be particularly true in the eastern part of the country where sulfur oxides play a dominant role in acid deposition. Nitrates are believed to contribute relatively more to the acid deposition problem in the western states than in the east. Although still small, the impact of the proposed relaxation may be somewhat higher in the western states except California where a more stringent NO_x standard is in effect.

I trust the above information will be of use to you. If I can be of further service, please contact me.

Sincerely yours,

WALTER C. BARBER,
Director, Office of Air Quality Planning and Standards.

STATE DEPARTMENT'S RESPONSES TO ADDITIONAL QUESTIONS SUBMITTED BY SENATOR DODD

Question 1. On August 5, 1980, the United States and Canada signed the "Memorandum of Intent" concerning transboundary air pollution. In that document both nations agreed to take interim actions to reduce transboundary air pollution. I believe other members of the Committee either have or will address the specific measures each country has taken or not taken to meet this commitment. In addition, since we are dealing with a question of bilateral relations with one of our two closest neighbors, I would like to know what indications of satisfaction or dissatisfaction the Canadians have expressed with regard to U.S. efforts to live up to the commitments made in the Memorandum of Intent.

Answer. The Memorandum of Intent on Transboundary Air Pollution of 1980 does include a provision on interim actions. At each meeting of the United States-Canada Coordinating Committee, and at the three negotiating sessions thus far, a portion of the meeting has been set aside for discussion of "interim actions". Papers have been tabled on the subject by both sides. The Canadians have questioned some of our recent regulatory actions and we have furnished explanations. Both countries have recently adopted special procedures to inform and consult with each other on regulatory and other decisions which might relate to the negotiations.

Question 2. Is the administration satisfied with Canada's efforts to live up to the commitments made in the Memorandum?

Answer. Not entirely. Ontario province has moved to require reduced sulfur dioxide emissions from Ontario Hydro power plants and from the International Nickel Plant at Sudbury. However, these reductions are several years away. In addition, plans by Ontario Hydro to increase power generation from the Nanticoke thermal plant would seem to increase, rather than decrease, emissions of possible precursors of acid deposition.

Question 3. Canada, like the United States, has experienced a substantial change of governments or change of administrations since bilateral discussions of the acid rain problem began between the two nations in 1976. Has the Canadian government's position regarding the issue altered substantially with that nation's changes in government? Has our position altered substantially with changes in administrations?

Answer. United States-Canada discussions on transboundary air pollution began in the fall of 1978, following a Congressional resolution proposing a cooperative agreement. The Canadian Liberal party has been the majority (government) party since that time, with the exception of a ten-month period in 1980 when the Conservatives held power. Whereas the United States originally proposed the negotiations, Canada has, throughout the period, indicated its desire for an agreement. This has also been the U.S. position. At his meeting with Prime Minister Trudeau in March 1981, the President expressed his personal support for the cooperative scientific work and the negotiations, although he noted he expected the negotiations would take some time.

Question 4. The administration's position, as I understand it, is that further research is needed before we can ascertain what, if any, additional measures should be taken to address the acid precipitation problem. What findings, Ms. Bennett, would the administration consider sufficient to justify a statutory requirement that sulfur dioxide and nitrogen oxide emissions, the chief suspected precursors of acids in precipitation, be substantially reduced as proposed in the Mitchell or Moynihan bills or by some other method?

Answer. Before substantial—and expensive—reductions in SO_2 and NO_x emissions are required by statute, we need to be certain that the mandated controls in fact will lead to reduced acid deposition in sensitive areas, and that the imposed costs will be balanced by benefits achieved in those areas.

Question 5. Mr. Niles, are the problems associated with the acid rain issue creating problems in other areas of our relations with Canada? If so, please elaborate.

Answer. The United States-Canada relationship is extremely broad and varied. We work closely together on many issues around the world. From time to time we do have differences over bilateral issues. We recognize that Canada places a high priority on dealing with the acid deposition issue. We are endeavoring to meet this need. While we do not fully agree with Canada on all matters relating air pollution, the issue is not causing problems in other areas of our relations.

Senator **Pressler**. So, with that I shall thank you very much and adjourn this hearing.

[Whereupon, at 12:30 p.m., the subcommittee adjourned, subject to call of the Chair.]

APPENDIX

NATIONAL COAL ASSOCIATION,
Washington, D.C., February 3, 1982.

Hon. LARRY PRESSLER,
Chairman, Subcommittee on Arms Control, Oceans and International Operations and Environment, Committee on Foreign Relations, U.S. Senate, Dirksen Senate Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: On behalf of the National Coal Association, I would like to have this letter inserted as part of the record for your Subcommittee's February 10 hearing on the subject of acid rain.

The current public controversy and scientific debate over the cause, effects and controls for acid rain underscores the need to proceed with caution. The heat of an election year is no time to institute acid rain controls, particularly when these controls would unfairly penalize coal burning powerplants and ultimately the rate payers.

New scientific evidence is emerging daily on the causes and effects of acid rain. Strong scientific evidence indicates that local industrial sources are the primary causes of acid rain rather than remote coal burning electric powerplants. In fact, a recent study conducted at the Atmospheric Sciences Research Center of the State University of New York stated that "there is no strong annual geographical gradient from which one could draw conclusions about the origin of acid rain or from which one could reasonably identify a source region." The report closed by stating that "the known source regions for precursor gases to 'acid rain' cannot yet be equivocally linked to receptors with the meteorological, physical and chemical information available today." Further evidence demonstrates that combustion of residual oil produces a higher percentage of sulfates than combustion of coal with a similar sulfur content.

To date, the scientific community has been unable to establish a link between increased acid precipitation and SO_2 emissions from coal fired electric utilities. In fact, SO_2 emissions generated by coal combustion have decreased by 13 percent since 1970 while coal use by electric utilities has increased by 78 percent during the same period. This would dictate that we proceed with caution.

We need to more carefully pinpoint the sources of acid rain and assess the economic trade-offs between controls and costs to consumers before we act. The approach manifest in S. 2027, as introduced by Senator Byrd, will accomplish this and represents the most prudent course to follow.

Lastly, Mr. Chairman, I am enclosing for your information a copy of statements presented by Mr. William N. Poundstone, Executive Vice President, Consolidation Coal Company and Mr. Joseph W. Mullan, Senior Vice President, National Coal Association. We believe these emphasize the need for accelerated research prior to imposition of additional emission controls.

I commend you for holding public hearings on this important matter.

Sincerely,

CARL E. BAGGE.

Enclosures.

STATEMENT OF WILLIAM N. POUNDSTONE, EXECUTIVE VICE PRESIDENT, CONSOLIDATION COAL CO.

INTRODUCTION

Good morning Mr. Chairman, members of the Subcommittee. I welcome this opportunity to talk on the subject of acid deposition. I am William N. Poundstone, executive Vice President of Consolidation Coal Company, a wholly owned subsidiary of Conoco Inc. I am also a member of the National Academy of Engineering. I am here representing the National Coal Association. During the course of the past several years we have been actively involved in studying the acid deposition issue. As a result of this activity I have personally participated in the review of the Interagency Task Force Report on Acid Precipitation and in numerous public conferences on this issue.

In an attempt to fully understand the important scientific investigations now underway we have held extensive discussions with investigators throughout the U.K., Canada, and Europe. In particular, we have closely followed the work of the Central Electricity Generating Board (CEGB) in the U.K. This organization has been involved for many years in intensive studies of all aspects of the acid deposition. This gives this research group a unique historical as well as scientific basis for judgments relating to trends and overall impacts of acid deposition.

The recent debate on the acid rain issue is becoming increasingly focused on development of mitigation strategies designed to address adverse impacts associated with acid deposition. For example, without adequate scientific documentation the National Commission on Air Quality (NCAQ) recommended in March, 1981, that Congress should require a significant reduction by 1990 in the current level of sulfur dioxide emissions in the eastern United States.[1] The National Clean Air Coalition (NCAC) has called for Congress to enact a program to curtail acid rain by reducing emissions from existing coal-fired power plants and other major sources of acid rain causing pollutants.[2] These recommendations implicitly assume that the causes and effects of acid deposition are well known, immediate action is necessary to prevent serious environmental damage, and mitigation measures can be formulated based upon available information. These strategies are based principally upon the premise that a direct correlation exists between SO_2 emissions and acid precipitation. We will show in this testimony that significant evidence exists to refute this assertion. In fact, this issue is extremely complex and the nature of the problem has not been fully elucidated.

As additional data have been developed and evaluated, and as historical data have been re-examined, it has become clear that serious inadequacies exist in our understanding of all aspects of acid deposition issue. Considerable doubt has now surfaced concerning the validity of previous conclusions related to both causes and effects. This is extremely important, since national policy developed on the basis of inadequate or poorly analyzed data is likely to result in the formulation of policies which will ultimately be ineffective.

In my opinion, American industry would support mitigation measures if: (1) the nature of the acid deposition problem, as determined by rigorous scientific evaluation, were clear and, (2) confidence existed that proposed mitigation measures will be effective. However, this is certainly not the present situation. Thus, it is essential, considering the enormous costs associated with emissions control programs, that prior to the imposition of new control requirements designed to deal with acid deposition, Congress be reasonably confident that such measures would: (1) result in meaningful reduction in the acidity of precipitation, and (2) significantly reduce the host of adverse environmental impacts which have been associated with acid deposition.

In our view, given the available data base, this cannot be done at this time. Therefore, should the Congress now attempt to initiate legislative and regulatory actions relating to acid deposition, a considerable risk exists that such measures will be grossly ineffective. The public will again have been mislead into believing that costly federal programs can be relied upon to produce societal benefits.

CAUSES

It is generally agreed that sulfur dioxide (SO_2) and nitrogen oxides (NO_x) interacting with other chemical species in the atmosphere, can act as acid precursors. The anthropogenic sources of these SO_2 and NO_x emissions include utility and industrial fuel combustion, industrial processes, and motor vehicles. In addition, natural biological and physical processes represent another significant source of these emissions. The conversion of these primary pollutants to sulfate and nitrate is influenced by a number of factors. These include relative humidity, temperature, sunlight, photochemical oxidants and atomospheric concentrations of catalysts, such as vanadium, manganese, nickel and carbon.[3] [4] The quantitative effect of each of these factors upon transformation of SO_2 into sulfate and NO_x into nitrate is poorly understood. Conversion of these primary emissions to sulfuric acid and nitric acid may increase the acidity of rainfall or snowfall, i.e., wet deposition, and may also increase the level of dry deposition.

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[1] Report of the National Commission on Air Quality, Washington, D.C., 1981.

[2] National Clean Air Coalition, Position on the Clean Air Act, 1981.

[3] P. J. Lioy, et al., The Occurrence of Ozone and Sulfates in the Northeastern U.S. Under Summertime Conditions, Paper No. 81-46, 3, Air Pollution Control Association, Philadelphia, 1981.

[4] K. A. Brown, Sulfur in the Environment: Review, Central Electricity Generating Board, No. RD/L/R, 1996 (1979).

Significant regional and seasonal differences exist in the composition of acidic deposition in the U.S. and Canada. Further, there exist substantial regional differences in soil composition and overall buffering potential. These should be recognized by the Congress in the formulation for policies designed to address the acid rain issue.

Mitigation measures have been suggested based upon the assumption that the principal cause of acid deposition in the Northeast U.S. and Eastern Canada is the long range transport of SO_2 and NO_x derived from coal-fired power plants in the Midwest, particularly those in the Ohio River Valley.[1 2] In an attempt to quantify the magnitude of impact from long range transport, models have been developed which seek to simulate the relationship between emissions from such sources and downwind precipitation acidity. However, it must be recognized that these models: (1) assume that there exists a linear relationship between SO_2 emissions, their transformation into sulfate, and ambient sulfate levels or deposition, (2) are not sufficiently sensitive to all of the meteorological and atmospheric factors which have been shown to be critical in explaining purported increases in sulfate levels in the Northeast U.S. and Canada, (3) have not been systematically verified, and (4) produce results, for any given set of conditions, which are in wide disagreement.[5] It is particularly critical to understand, as stated by Dr. Volker Mohnen in his recent testimony before the EPA, that recent studies * * *

> Clearly indicate that there is not linear relationship between SO_2 emissions in the Midwest, their transformation into sulfates, and ambient sulfate levels in the Northeast. They show that a number of meteorological and photochemical factors are involved, and appear to be more important than the magnitude of upwind SO_2 emissions in explaining elevated sulfate levels in the Northeast.

Further, Dr. Mohnen maintains that these

> "More recent and more sophisticated analyses indicate that SO_2 emission levels of sources in the Midwest are not an important determinant of elevated ambient sulfate levels in the Northeast" and . . . "It follows, therefore, that a change in SO_2 emissions from those sources would most likely not result in a measurable change in sulfate levels in New York and Pennsylvania."[5]

It should be noted that this conclusion undermines the basis of the fundamental NCAQ and NCAC recommendations with respect to acid rain.[1 2]

It is also extremely interesting to note that even if these critical findings were systematically disregarded and that the long range transport models are assumed to be valid, recent studies conducted by a U.S./Canadian Memorandum of Intent Working Group indicate that the contribution from Ohio River Valley power plants to acid deposition in the Adirondacks is far less than previously thought. In fact, the Province of Ontario appears to contribute as much as the power plants in Ohio and as much as sources in New York and New England to such acid deposition.[6] This result, is totally contrary to the popular public and media perception of the problem.

The role of local man-made and natural sources may also be significant in determining the magnitude and extent of observed acid deposition.[5 7] Examples of man-made anthropogenic sources which are found throughout the Northeast U.S. and Canada are: regionally located coal and oil-fired powerplants, industrial and motor vehicles. In fact, the largest single source of SO_2 in North America is the Sudbury smelter in Ontario, Canada. Natural contributions to acid deposition are the result of plant decay. The products of the decay process can readily migrate in the form of gaseous species, particulate matter, or in aqueous solution.

PRECIPITATION

Public attention associated with acid deposition has focused upon purported increases in precipitation acidity. However, it is clear from several recent critical analyses of historic rainfall data that the available data do not support the allegation that there exist long term trends in precipitation acidity.[8] This finding is based upon a correction of historical data for differences in analytical methods and contribution of extraneous factors.[8] Thus, this work provides a solid basis upon which to strongly question the conclusion reached two years ago by the Council on Environmental Quality (CEQ) that a 50 fold increase in precipitation acidity had occurred in the Eastern U.S. over the past 25 years.[9] Surely, this conclusion should be reassessed in light of these important findings.

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[5] V. A. Mohnen, Statement Before U.S. EPA, Docket No. A81-09, 1981.

[6] U.S.-Canada, Memorandum of Intent on Transboundary Air Pollution-Interim Report, 1981.

[7] M. S. Esposito, et al., U.S. Department of Energy, Acid Rain: The Impact of Local Sources (Morgantown Energy Research Center), Office of Fossil Fuel, 1980.

Further, these analyses show that the geographic extent of areas identified as receiving acid deposition has not increased.[8] In addition, it should be noted that it is not necessarily precipitation acidity but rather the total deposition of hydrogen ions which determine the extent of environmental impact. It has been shown that total annual hydrogen ion deposition is controlled by meteorological factors and does not correlate directly with man-made emissions.[5] [10] Thus, although increasing acidic precipitation has been identified as the principal cause of a set of adverse environment impacts, many other factors must be examined.

SURFACE WATER ACIDIFICATION

Some field studies have indicated that acidification of lakes in the Adirondacks and Eastern Canada has taken place over the last 35–40 years.[11] [12] However, a careful analysis of the available data suggests that these previous conclusions were based on a limited sample of lakes and that the reported rate and overall magnitude of the increase in lake acidity may not be correct.[13] Recent work shows that the use of different analytical methods used during the study period, and the reliance upon inconsistent data sets caused a significant overestimate of the severity of lake acidification in the Adirondacks.[13]

Specifically it has been shown that water which has a pH value of 4.0 as measured by the modern potentiometic method would be reported as 5.2 by the older colorimetric technique. Thus for lakes with pH values in this range there exists a systematic bias of 1.2 pH units (representing a sixteen fold difference in relative acidity).[13] This bias is of the same magnitude as the increase in lake acidity which have been reported in the literature.[13] Thus, it is difficult to detail any change in the pH of Adirondack lakes over the last 40 years.[14]

Even if there is acidification of some lakes, there are factors other than precipitation acidity which may be the cause. It has been determined that of 192 Adirondack lakes which have been the object of significant study, 117 or 61 percent are immediately adjacent to or appear to be influenced by swamps or peat bogs.[15] It has been well documented that such bogs can act as substantial sources of naturally occuring acids.[16]

Further, findings from recent studies of historical data call into question the previously accepted judgments relating to the rate and severity of lake acidification. For example, a recent study conducted by the Ontario Ministry of the Environment indicates that less than five percent of the 1665 lakes sampled were acidified and "almost all of the acidified lakes are in the Sudbury area and are believed to have been directly affected by local sources." [17]

Certainly, the acidification of lakes and other water bodies is a complex process. Factors such as a bedrock geology, soil composition and land use practices, in addition to precipitation acidity control surface water quality, and may have a far greater impact than the effects of acid rain.[14] [15]

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[8] D. A. Hansen, et al., Examination of the Basis for Trend Interpretation of Historical Rain Chemistry in the Eastern United States. Environmental Research & Technology, Westlake, California, Document No. P–A–097, 1981.

[9] Council on Environmental Quality, Tenth Annual Report, 1979.

[10] V. A. Mohnen, Acid Precipitation in the Eastern United States, IEEE Power Engineering Society Special Session on Acid Rain, Atlanta, 1981.

[11] C. L. Schofield, Acid Precipitation : Effects on Fish, Ambio 5 (1976).

[12] Ontario Ministry of the Environment, The Case Against Acid Rain, 1980.

[13] M. H. Pfeiffer and P. Festa, Acidity Status of Lakes in the Adirondack Region of New York in Relation to Fish Resources, New York State Department of Environmental Concern (FWP 168 10/80), 1980.

[14] P. F. Chester, Acid Rain, SO_2 Emissions and Fisheries, IEEE Power Engineering Society Special Session on Acid Rain, Atlanta 1981.

[15] W. C. Retzsch and A. G. Everett, Influence of Natural Acidity and Fisheries Management Acativities Upon the Status of Adirondack Fissh Populations, American Petroleum Institute, 1981.

[16] K. A. Brown, The Distribution of Sulfur Compounds in a Peat Bog in Relation to Stream Water Chemistry, Central Electricity Research Laboratory, No. RD/L/N 89/80, 1980.

[17] Ontario Ministry of the Environment, Acid Sensitivity Survey on Lakes in Ontario, AP1 002/81, 1978.

AQUATIC EFFECTS

A number of studies indicate that an increase in the number of fishless lakes has been observed in the Adirondacks, Eastern Canada and parts of Scandinavia.[11 18 19] However, a critical evaluation of these data has indicated that: (1) the number of affected lakes is small and consist of only those located at high altitudes, (2) many of the lakes identified as fishless have historically supported small or no fish populations, (3) species of commercial and recreational value are in many cases not naturally present in such lakes, and (4) the incidence of fishlessness and the reduction of diversity of fish populations may be the result of many other factors.[14 15]

A recent detailed study of Norwegian lakes has shown the incidence of fishless lakes to be independent of sulfate concentration below a pH of five. [20] In addition, the correlation of fishlessness with the other factors such as lake area appear to be as strong as the correlation with sulfate.[14 15 21] Therefore, no simple relationship exists between acidification and adverse aquatic effects.

SOILS/VEGETATION EFFECTS

It has been suggested that acid deposition adversely impacts soils, vegetation, may cause damage to forest systems, and may affect the yield of agricultural crops.[2 12 22] However, field studies conducted at conditions representative of actual precipitation acidity have not provided confirmable evidence that such adverse impacts do indeed occur.[23 24]

Perhaps most importantly, the U.S. Forest Products industry, which would be most susceptible to economic losses as a result of decreases in forest productivity, has indicated through the National Council of the Paper Industry for Air and Stream Improvement that, "* * * The current state of knowledge does not allow any definitive conclusions to be reached regarding the effects of acidic deposition on forest productivity." [24] Further, although it has been charged that acid deposition can lead to a reduction in microbial activity and therefore, to diminished nutrient availability, soil studies now underway in England have not supported this conclusion.[23]

MATERIALS EFFECTS

Claims have been made that acid rain is causing damage to buildings, monuments, statuary, paints and metal structures.[22] This disfigurement of such priceless ancient artifacts as the Parthenon is often cited as an example.

It has been recognized for many years that various acidic species in polluted air contribute to the corrosion of materials. However, such damage is generally associated with local sources of air pollution. The serious damage done to the artifacts of Athens and Rome is almost certainly the result of the very substantial levels of uncontrolled local pollution not acid rain.[25]

RESEARCH STRATEGY

Research in the following areas is needed to provide the basis for the development of effective mitigation strategies.

1. The factors associated with the conversion of SO_2 and NO_x into sulfates and nitrates.

2. The nature of the transport and diffusion of acid precursors and their downwind deposition in wet and dry forms.

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[18] R. F. Wright and E. Snekuk, Acid Precipitation: Chemistry and Fish Populations in 700 Lakes in Southwest Norway, Verh. Inst. Verien. fur Liminologic, 20, 1978.

[19] R. J. Beamish and H. H. Harvey, Acidification of the La Cloch Mountain Lakes, Ontario and Resulting Fish Mortalities, Journal. Fish, Research Board—Canada, 29 (1972).

[20] D. J. A. Brown and K. Sadler, The Chemistry and Fishery Status of Acid Lakes in Norway and their Relationship to European Sulfur Emissions, J. Appl. Ecology, 18 (1981).

[21] I. Th. Rosequest, Alternative Sources for Acidification of River Water in Norway, Sci. Totl. Env. 10 (1978).

[22] U.S. EPA: Acid Rain, EPA-600/9-79-036, July 1980.

[23] J. E. Rippon, The Effects of Acid Rain on Soils, Central Electricity Research Laboratories, No. LM/BIOL/056, 1979.

[24] National Council of the Paper Industry for Air and Steam Improvement, Acidic Deposition and Its Effects on Forest Productivity: A Review of the Present State of Knowledge, Research Activities, and Information Needs, 1981.

[25] K. Lal Gauri and G. C. Holdren, Jr., Pollutant Effects on Stone Monuments, Environmental Science and Technology, 15 (1981).

3. The relative contributions of acid precursors from powerplants, industrial operations, commercial and residential fuel combustion, mobile sources, and natural sources to ambient sulfate and nitrate concentrations.

4. The relative contributions of long-range transport, local anthropogenic sources, and natural biological processes to actual acidic loadings.

5. The relative contributions of acid deposition, other anthropogenic activities, geologic factors, and natural biological processes on surface water acidification.

6. The relationship among surface water pH, water chemistry and diminished fish population.

7. The impact of land use practices, man's use of chemicals stocking practices, and fishing pressures upon the quantity and diversity of fish species found in fresh water lakes.

MITIGATION STRATEGIES

Several policy recommendations have been made which deal with the projected adverse impacts associated with acid rain. These can be placed into two generic classes based upon the extent of perceived contributions to acid deposition from large coal-fired sources. The first involves uniform SO_2 emissions reduction from existing powerplants in the Ohio River Valley. Several methods could be employed to effect such reductions. These include: mandatory coal washing, use of low sulfur coal, and flue gas desulfurization.

The second class of mitigation measures revolves around the concept that SO_2 emissions increases from large coal-fired stations should be minimized. The three basic principles involved include: (1) no (or delayed) SO_2 SIP relaxations, (2) plants converted from oil to coal be required to operate with no net increase in SO_2 emissions, and (3) maintenance of stringent 90 percent reduction of SO_2 emissions from all new high sulfur coal-fired powerplants.

These policies assume that a reduction in man-made sources of SO_2 will significantly reduce the adverse impacts ascribed to acid rain and there exists a direct relationship between SO_2 emissions and precipitation acidity. As pointed out in my testimony, this conclusion is indeed questionable. Not only the work of Mohnen and others in the U.S., but European studies provide a strong basis for refutation of this conclusion.[5, 20, 26] Specifically, a recent statistical analysis of data obtained from Scandinavian precipitation network shows that although a 35 percent increase in SO_2 emission from Northwestern European sources took place between 1963 and 1975, a downward trend of 25 to 40 percent was measured in annual sulfate deposition and no trend was detected in the concentration of sulfate in the precipitation.[27] Certainly, this example of such complete lack of correlation must be addressed prior to the implementation of any SO_2 emissions reduction strategies.

Even if a direct relationship were to be assumed between SO_2 emission and precipitation acidity, recent work has shown that little improvement in lake water quality will be realized. Specifically, a recent study based upon Norwegian data indicates that a 50 percent decrease in Northwestern European SO_2 emissions will improve the fishless situation in only 2 percent of the affected lakes.[20]

CANADIAN-U.S. RELATIONS

On August 5, 1980 the U.S. and Canada signed a Memorandum of Intent on Transboundary Air Pollution. Work groups were formed to investigate the causes of and effects associated with transboundary air pollution. An interim report was published in February, 1981; a final report is due in early 1982. Treaty negotiations were to commence in June 1981.

The U.S. Congress passed the Acid Precipitation Act (Title VII of the Energy Security Act) in 1980. This Act established an Interagency Task Force on Acid Precipitation. This task force was charged with the responsibility of design, coordination, and implementation of a 2 year research plan designed to provide answers to the "acid rain problem".

Former EPA Administrator Douglas M. Costle wrote letters to Senators Muskie and Mitchell on January 13, 1981, which reach the conclusion that acid deposition is causing significant harm in both the U.S. and Canada. He also concluded that Canadian legislation satisfies the Clean Air Act Section 115 requirements. These conclusions were deemed adequate to warrant the initiation of Section 115 State Implementation Plan review process.

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[26] G. M. Hidy, Statement Before U.S. EPA, Regarding Petitions of New York and Pennsylvania Under Section 126 of the Clean Air Act, 1981.

[27] L. Granat, Sulfate in Precipitation as Obbserved by the European Atmospheric Chemistry Network, Atmospheric Environment, 12 (1978).

POLICY RECOMMENDATIONS

Based upon this testimony, I hope that you will agree that there exist considerable uncertainties associated with the fundamental knowledge of the causes and effects of acid deposition. We believe that the National Acid Precipitation Assessment Plan can serve as a firm foundation for developing sound scientific data and thereby addressing these uncertainties.

This objective may be even more effectively accomplished if the following steps were taken: (1) additional participation by non-governmental representatives on the Task Force, and (2) annual review of the program, and (3) peer review of program results. Further, the research program should be adequately funded and vigorously implemented.

SUMMARY

In conclusion, based upon a careful review of recent scientific evidence, it is clear, that:

1. No trends have been documented which indicate a rapid increase in precipitation acidity in the Northeast U.S. or Canada or in increases in the geographic extent of areas receiving acidic rain.
2. Models designed to simulate the relationship between sources of acid precursors and downwind receptors are yet to be validated. In addition, based upon any given set of conditions these current models will show widespread disagreement. As a result, they cannot be utilized to predict specific source impacts.
3. Re-examination of existing published data indicate that the extent of surface water acidification in the Northeast U.S. and Canada is extremely limited and is less severe than generally conceived.
4. A re-examination of available data relating to fisheries status in Adirondacks lakes purported to be affected by acid deposition, has shown that a significant number of these lakes have been either historically fishless or have had limited ability to support aquatic life.
5. Recent work has indicated that a number of factors unrelated to surface water pH may be more important in determining the viability of lake fish populations.
6. Field studies conducted at conditions representative of actual precipitation acidity have not provided evidence that damage has occurred to terrestrial ecosystems including soils, forests, and crops.

There exist no valid scientific arguments that proposed legislative and regulatory policy directed at the reduction of SO_2 emissions will result in a corresponding reduction in rainfall acidity. However, even if such a reduction in precipitation acidity were to occur, it is uncertain that any meaningful beneficial impact on surface water pH or fish populations would result. Therefore, considering (1) the enormous costs of emissions reduction and (2) the present uncertainty of the effectiveness of mitigation measures, it is inappropriate at this time to focus our attention on mitigation policies. There is sufficient time to conduct and implement the recommended research program without serious risk of damage to the environment.

PREPARED STATEMENT OF JOSEPH W. MULLAN, VICE PRESIDENT OF THE NATIONAL COAL ASSOCIATION

Good afternoon, Mr. Chairman and members of the subcommittee. I am Joseph W. Mullan, Vice President of National Coal Association, an association of coal producers, sales companies and organizations with an interest in the coal industry. We appreciate this opportunity to discuss research and development programs aimed at a fuller understanding of the phenomenon of acid precipitation.

INTRODUCTION

In the past several years, and particularly since enactment of the 1977 Clean Air Act amendments, there has been increased attention on the causes and potential effects on terrestrial and water systems of acid deposition or more popularly referred to as "Acid Rain." Acid deposition exists, and varying effects do occur, but there is considerable debate over the circumstances of its formation and the feasibility of potential controls. The scientific community has seen the same data on acid deposition and invariably has reached differing conclusions and thus uncertainties. I will not belabor this subcommittee with an extensive review of what the coal industry believes to be the known facts in this matter.

Rather, I would request that testimony prepared and presented by William N. Poundstone, Executive Vice President of Consolidation Coal Company to the subcommittee on Health and Environment of the House Committee on Energy and Commerce be made part of the official record of this hearing. Mr. Poundstone is a noted authority on the acid deposition issue and speaks to the fundamental technological and scientific questions of the debate.

To resolve the controversies involved in the acid precipitation question, the critical, unresolved issues surrounding the phenomenon must be carefully considered. The American people have the right to expect that their Government will not impose an additional multi-billion Dollar program without first determining with some certainty commensurate social and environmental benefit. Congress recognized the importance of careful evaluation of the phenomenon when it enacted a comprehensive program aimed at understanding the causes and effects of acid deposition in the Energy Security Act of 1980.

There are those, however, that have characterized the National Acid Precipitation Assessment Plan and its 10 year frame established under Title VII of the Energy Security Act as protracted delay. The coal industry does not wish to use unanswered questions as an excuse for delay. We, therefore, strongly endorse H.R. 5055 which calls for an accelerated effort to understand the causes and effects of acid precipitation. We favor intensification of research efforts aimed at producing defensible results within 5 years. However, in order that meaningful results are produced in this accelerated time frame, it will be necessary to concentrate on carefully defined objectives. This will require a well planned, coordinated effort by Government and industry. As noted by the recent General Accounting Office report, the acid rain debate is "unnecessarily confused by inaccurate and misleading statements." It is our hope that a well defined research effort will alleviate these concerns.

Research needs

To help insure meaningful and effective results, NCA believes that accelerated research in the acid deposition debate be concentrated in the following areas:

1. Extension and refinement of the current data base;
2. Transport, transformation and deposition processes;
3. Mitigation and coal cleaning.

Specifics

1. Extension and refinement of the current data base.—Much of the confusion and controversy surrounding the entire acid deposition issue emanates from diverse and conflicting data. Varying sampling methods, frequencies, analytical techniques, along with a lack of quality control, have resulted in an, at best, questionable data base. In an effort to obtain reliable monitoring data and evaluate the conflicting claims regarding acidity trends, the National Coal Association has instituted a comprehensive monitoring network that extends from the Rockies to New England and Canada. The program is designed to avoid many of the problems of the past. The end result should be an improved and expanded data base for determining actual acid precipitation as a function of time and place. It is the hope of NCA that any accelerated research on the part of the USEPA and the interagency task force will include an expanded, well defined and maintained network of monitoring stations incorporating the previously mentioned objectives. Without a reliable data base as a basic foundation other research will no doubt yield questionable results.

2. Transport, transformation, and deposition processes.—The question of the precise causes of the acid rain phenomenon remains unanswered. At present, no one has been able to determine the extend to which airborne emissions are contributing to the acidification of deposition, whether wet or dry. Likewise, no one can determine what effect anthropogenic emission reductions would have on current levels of acidity. Without the answer to these questions, or at the very least a far better understanding than we currently have, we cannot with sufficient confidence develop programs to reduce or control acid deposition. What is clear, however, is that the chemistry involved in the formation of acid rain is complex and is not understood. For example, uncertainty regarding chemical transformation prevents scientists from establishing exactly how sulfates and nitrates are derived, their origin and how they could be controlled.

Long range transportation is also the subject of considerable controversy. Acid precipitation in the northeast has routinely been attributed to emissions from industrial sources located in the midwest. The basic argument underlying this assumption, i.e., that significant percentages of emissions are typically transported over long distances, has not been verified with any degree of scientific scrutiny. Two separate studies have recently augmented our position. The first, a Department of Energy study entitled "Acid Rain: The Impact of Local Sources" suggests that the long range transport of emissions from coal fired power plants may not play as significant a role in determining downwind sulfate levels as has been alleged. Likewise, the Federal Interagency Task Force on Acid Precipitation in the National Acid Precipitation Assessment Plan concluded that it is not possible to determine with confidence the extent to which any specific source or collection of sources in one region lends to acid deposition in another region."

The final unknown in the acid deposition sequence is cloud chemistry. The role of cloud chemistry is quite significant, since the incorporation of atmospheric pollutants in precipitation may be influenced by a variety of factors unrelated to ambient levels of apparent precursors. Until this phenomenon is more clearly understood, claims involving the formation of acid deposition cannot be satisfactorly evaluated. NCA, therefore, urges that the transformation transport and ultimate deposition of airborne pollutants be quantified through scientifically defensible approaches. Intense atmospheric process research is a must if we are to obtain a better understanding of the actual mechanism of the phenomenon.

3. Mitigation efforts.—Given the vast uncertainty that at this time surrounds the causes and effects of acid deposition, there is little or no agreement on how much precipitation quality would change even if substantial emission reductions were imposed. Without, at the very least, preliminary results from the aforementioned research projects, no one knows what effect any emission reductions, particularly at distant sources, would have on precipitation quality.

Since the causal relationship between emissions and ecological impacts associated with acid deposition is so uncertain, NCA believes it would be far more effective if specific ecological concerns were identified and measures were instituted to remedy the problems directly. As reported by GAO, the only clear evidence of harm from acid rain involves the possible acceleration of aquatic acidification in naturally sensitive lakes. Since lakes typically acidify as a result of an inability to buffer incoming acidity, the replacement of natural alkaline agents could in theory address this problem (and has done so in the past). Analyses of lake restoration projects that have already been undertaken confirm that the addition of limestone may constitute a potentially effective mechanism for combatting lake acidification. Researchers report that the introduction of lime has led to: (1) increases in pH, (2) increases in the diversity of phytoplankton and zooplankton species, (3) better balances in total fish biomass and (4) decreases in concentrations of potentially toxic heavy metals. While liming is not feasible everywhere, it may be an important interim measure to mitigate the effects of acidification until there is more certain knowledge of its causes. This and other mitigation measures should be pursued vigorously while the necessary research to determine causes of environmental acidification is underway.

4. Coal cleaning.—Due to the substantial level of coal washing already being pursued, the emissions reductions from a broad coal washing program may be relatively small. However, when used on selective coals, coal washing is a relatively cost-effective means of precombustion emissions reduction. Given this fact, NCA would urge that further research be conducted on all areas of coal cleaning. For example, NCA has actively participated in two projects involving coal cleaning with EPA. The first addressed the critical sulfur variability of raw or run of mine coal versus the same coals that have been processed. The second project analyzed the environmental impact of increased coal cleaning outlining air, water, soil and biological conditions. Both studies were well conceived and expertly conducted. Due to budgetary constraints, however, these critical projects were terminated prior to final completion. NCA urges that such projects as these become an integral part of any accelerated research on acid deposition.

Conclusion

Acid deposition is a reality—one of major concern. The depth of our concern about acid deposition should be reflected in public policies that are based upon sound science. In passing the Acid Precipitation Act of 1980, Congress itself established a comprehensive intergovernmental and interdepartmental research plan so that the complexity of acid deposition could be fully understood. To the extent that H.R. 5055 and H.R. 4830 call for an acceleration of this research effort, NCA wholeheartedly concurs. We caution against and would strongly object to, however, any attempt to impose additional emissions regulations prior to completion of the necessary research. The expenses associated with significant emissions reductions will be very great.

This concludes my prepared statement. I would be happy to respond to any questions you may have.

HUNTON & WILLIAMS,
Washington, D.C., February 25, 1982.

Hon. CHARLES H. PERCY,
Chairman, Senate Foreign Relations Committee,
Dirksen Senate Office Building, Washington, D.C.

DEAR SENATOR PERCY: During a February 10, 1981 hearing on "acid rain" held by Senator Pressler's Subcommittee on Arms Control, Oceans and International Operations, and Environment, Mr. Pressler invited witnesses to provide additional information for the record to assist the subcommittee in its deliberations. On behalf of Dr. William B. Harrison, the Edison Electric Institute's witness, I would like to supplement the record with respect to three issues: first, the advisability of relying upon the often-cited "NAS Report" in evaluating acid rain legislation; second, the validity of claims that acid rain harms crops and soils; and third, the specific scientific and legal flaws associated with the emission reduction requirements that would be established by Senator Mitchell's Acid Deposition Control Act (S. 1706).[1]

A. THE NATIONAL RESEARCH COUNCIL REPORT

In testifying before Senator Pressler's subcommittee, Senator Mitchell relied extensively upon a 1981 report released by the Atmosphere and Biosphere Committee of the National Research Council.[2] Senator Mitchell indicated that the conclusions reached in chapter 8 of the report constitute the *central technical justification* for the 10,000,000 ton SO_2 reduction scheme that he has devised.

EEI believes that the credence given the report by the Senator may be misplaced, in view of the serious reservations that have recently been expressed as to its accuracy and its role in the legislative process. In recent testimony before the Senate, Dr. Volker Mohnen commented at length on the paucity of scientific support for S. 1706 and the inadvisability of relying upon the NRC study:

> [T]he hypothesis that reductions in SO_2 emissions from distant sources in the Midwest will decrease acid rain in the Northeast is not supported by the *scientific* research that had been conducted on acid rain. Based on our limited present understanding of acid rain, it is impossible to predict the changes, if any, in wet and dry deposition that the emission reductions that would be required by this bill would have in the environmentally sensitive areas of the Northeast.
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> * * * * * * *
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> In light of what I have said, I am surprised to observe that many persons appear to believe that the control strategy required by S. 1706 is adequately supported by science. A study relied upon by some as support for S. 1706 is the recent report of the National Academy of Science . . . . That report concludes (on page 181) that control of SO_2 and NO_x emissions "can significantly reduce the rate of deterioration of sensitive freshwater ecosystems," that it is desirable for such areas to have pH values no lower than 4.6–4.7, and that in the most seriously affected areas "this would mean a reduction of 50 percent in deposited hydrogen ions." Because I am not an expert on the ecological effects of acid rain, I am in no position to comment on whether the ecological damage caused by acid rain justifies the report's recommendations of a 50 percent reduction in deposited hydrogen ions for those areas most seriously affected. However, I have shown in this statement that it is wholly erroneous to assume, as S. 1706 appears to do, that a reduction in SO_2 emissions of 50 percent or 10 million tons will yield a reduction of 50 percent in deposited hydrogen ions.[3]

A September 1981 analysis of the report's chapter 8 by Environmental Research and Technology (enclosure 1) confirms Dr. Mohnen's skepticism, as does the Academy's recent decision to reevaluate the conclusions reached by the Atmosphere and Biosphere Committee.

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[1] Our evaluation of Senator Mitchell's bill applies equally to legislation introduced by Representatives Moffett (H.R. 4829) and Waxman (§ 104 of H.R. 5555), since these bills adopt requirements substantially similar to those in S. 1706.

[2] Committee on Atmosphere and Biosphere, *Atmosphere-Biosphere Interactions: Toward a Better Understanding of the Ecological Consequences of Fossil Fuel Combustion* (1981). Although frequently referred to as the "NAS Report," the analysis is actually a product of the National Research Council, an organization that has been delegated research responsibility by the National Academy of Science (NAS).

[3] Testimony of Dr. Volker Mohnen, Director Atmospheric Science Research Center; State University of New York at Albany before the Senate Committee on Environment and Public Works 3, 26–27 (November 5, 1981).

B. THE VALIDITY OF CLAIMS REGARDING CROP AND SOIL DAMAGE FROM ACID RAIN

During the subcommittee hearing, Senator Pressler repeatedly inquired into allegations that crops and agricultural soils are threatened by acid rain. In view of the Senator's interest, we have enclosed a memorandum briefly summarizing the conclusions of prominent researchers that have investigated the issue (enclosure 2). The memorandum demonstrates that agricultural management practices (fertilization) introduce *far* more acidity into soil ecosystems than precipitation. Moreover, field evaluations of acid rain impacts provide little support for the crop and soil damage claims advanced by the proponents of costly emission controls.

C. THE SCIENTIFIC AND LEGAL FLAWS ASSOCIATED WITH THE MITCHELL-WAXMAN LEGISLATION

Finally, EEI's submittal addresses the specific scientific and legal flaws that are inherent in the emission control programs advocated by Senator Mitchell and Representative Waxman. We rely upon two detailed statements EEI has submitted to Representative Waxman's House Subcommittee: first, Al Courtney's evaluation of the serious scientific weakness in the acid rain "chain of causation" theory propounded by environmentalists; and second, Kurt Anderson's discussion of the bill's devastating impacts upon new industrial development, coal conversions, employment and economic prosperity in the East (enclosures 3 and 4).

We appreciate Senator Pressler's invitation to supplement the record and hope that the enclosed materials will assist the Committee in dispassionately evaluating the often emotional claims that have characterized the acid rain debate.

Sincerely,

PETER S. EVERETT.

Enclosures.

[MEMORANDUM]

FEBRUARY 25, 1982.

To: Staff, Senate Foreign Relations Committee, Subcommittee on Arms Control, Oceans and International Operations, and Environment.

From: Edison Electric Institute.

ALLEGATIONS OF ACID RAIN IMPACTS UPON CROPS AND AGRICULTURAL SOILS

During Senator Pressler's February 10, 1982 Subcommittee hearing on acid rain, he invited participants to supplement the record where appropriate, and specifically solicited information regarding possible impacts upon crops and agricultural soils. In response to Senator Pressler's request, we have summarized conclusions reached by prominent scientists and researchers regarding crop and soil issues. As the following statements make clear, acid rain is, on balance, unlikely to result in significant adverse effects.

I. CONCLUSIONS DRAWN BY THE UNITED STATES-CANADIAN IMPACT ASSESSMENT WORKGROUP

In connection with the 1980 U.S.-Canadian Memorandum of Intent on transboundary air pollution, the United States and Canada have formed an Impact Assessment Workgroup to study allegations regarding the ecological effects of acid rain. In the Workgroup's most recent report,[1] the authors reached the following conclusions:

A. The contrast between field study results and claims regarding crop losses

1. [T]here is, as yet, no conclusive documentation of [direct effects on crops] . . . occurring in the field as a result of acid precipitation.

Impact Assessment Report at 4–29.

2. No unequivocal examples of foliar symptoms produced by acid precipitation on field-grown vegetation have yet been reported in North America.

Impact Assessment Report at 4–4.

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[1] Impact Assessment Working Group I. Phase II Interim Report (October 1981) (hereinafter cited as Impact Assessment Report). Citations to the reports of individual researchers are provided at the end of the memorandum.

3. Field-grown plans may be less susceptible to the development of foliar symptoms than plants grown under controlled or semi-controlled conditions.

Impact Assessment Report at 4-9, *citing* Jacobson (1980) and Shriner (1978).

B. The equivocal results of laboratory experiments on crops

[E]xperimental studies with simulated acid precipitation have produced both positive and negative results (Jacobson, 1980; Shriner, 1978). Increases and decreases in yield, as well as no significant effects, have been found, depending on concentrations of acids, plant species and cultivars, pattern and timing of rain applications, and soil, environmental, and cultural conditions (Irving and Miller 1980; Lee *et al.*, 1980). Each species may thus have unique patterns of physiological and genetic responses to the potentially beneficial and detrimental components of acid precipitation.

Impact Assessment Report at 4-4.

C. Agricultural soils' immunity to acid precipitation

Agricultural areas do not usually include the shallower soils which would be more sensitive to impacts from acid precipitation. The effects of fertilization and liming of agricultural soils will generally mask any direct effects of acid precipitation on the soil. In addition, acid precipitation could help offset S deficiencies in some soils . . . [T]he current state of knowledge suggests that the implications of air pollution for agricultural soils are that the direct effects will be minimal.

Impact Assessment Report at 4-28 and 4-29.

II. EPA CONCLUSIONS REGARDING ALLEGATIONS OF CROP AND SOIL IMPACTS

In reviewing the current national ambient air quality standards for sulfur dioxide (SO_2) and particulates (TSP), Environmental Protection Agency (EPA) scientists have conducted detailed evaluations of studies assessing crop and soil impacts. Excerpts from the acid rain discussion in EPA's SO_2/TSP criteria document[2] reveal that the "imminent damage" alluded to by environmentalists is nonexistent.

A. The results of field and laboratory studies

[T]o date, there are no confirmed reports of exposure to ambient acidic precipitation causing foliar symptoms on field grown vegetation in the continental United States and Canada.

Draft Criteria Document at 7-80, citing Jacobson (1980a) and personal communications with Linzon on the part of the EPA authors.

B. Fertilization from atmospheric deposition

1. Irving (1979) reported a higher chlorophyll content and an increase in the rate of photosynthesis in field grown soybeans exposed to simulated rain at pH 3.1. She attributed the increases to improved nutrition due to the sulfur and nitrogen components of the simulated acid rain overcoming any negative effects.

Draft Criteria Document at 7-87.

2. Irving and Miller (1978) observed that an acidic simulant had a positive effect on productivity of field grown soybeans as reflected by seed weight. Increased growth was attributed to a fertilizing effect from sulfur and nitrogen delaying senescence.

Draft Criteria Document at 7-88 and 7-89.

3. Experimental data have shown that even though plants are supplied with adequate soil sulfate they can absorb 25 to 35 percent of their sulfur from the atmosphere.

Draft Criteria Document at 7-77, citing Brady (1974).

CONCLUSION

The claims of widespread crop and soil damage that have been lodged by the advocates of stringent emission controls are simply not credible. Field research that has been conducted to date reflects little adverse acid rain impacts on crop yield and soils, and the results of laboratory studies—even when conducted with highly acidic rain—suggest that yield improvement could occur as readily as reductions. Dr. Thomas Hutchinson, professor of Botany at the University of Toronto, recently concluded that:

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[2] Air Quality Criteria for Particulate Matter and Sulfur Oxides. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency. (Draft Final, December 1981).

> * * * There is little solid evidence to date of the occurrence of visible or even detectable damage to terrestrial ecosystems caused by the acid precipitation events of the past twenty years. . . . The reasons for this lack of damage to date are believed to be of several kinds. One is that naturally acidic soils are very widespread, especially in those areas experiencing lake acidification. Forest growth and the essential soil processes are thus able to function at low pH (3.4–4.5). A second factor is that most soils have a relatively high buffering capacity which is contributed by their base status, by carbonates, by organic content, and by the clay minerals. Agricultural soils are traditionally limed, as required, to maintain pH in a desirable range for plant growth. . . . [F]ertiliser and lime additions would far outweigh deleterious impacts of H^+ ion additions.

Hutchinson, (1980).

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PREPARED STATEMENT OF KURT D. ANDERSON

Committee Members, Ladies and Gentlemen: My name is Kurt D. Anderson and I am Environmental Affairs Manager for the New York Power Pool, an association of the electric systems in the state of New York. I am appearing today on behalf of the Edison Electric Institute—the trade association of the electric utility industry. My past experience includes ten years with New York State pollution control and research agencies as an environmental engineer. In my present position with the New York utilities, I am involved in various environmental regulatory policy matters and I am responsible for the implementation of an extensive environmental research program that includes substantial acid precipitation research. It is with the perspective of a former regulator and now a utility industry spokesman that I offer my comments today.

I would like to thank the members of the Committee for giving me the opportunity to testify today on the sulfur dioxide emission reduction program in Congressman Waxman's bill. The program—contained in § 104 of the bill—would amend the Clean Air Act to establish stringent, costly SO_2 emission reduction requirements for major stationary sources in the 31 states bordering on and east of the Mississippi.

I. INTRODUCTION

Before addressing the bill's specific provisions, I'd like to make it clear that we believe the emission reduction program contained in H.R. 5555 is unwarranted and that we oppose the bill. We believe that the proposal, in departing dramatically from the approach Congress endorsed in enacting the Acid Precipitation Act of 1980,[1] ignores the pervasive scientific uncertainty that surrounds the acid deposition phenomenon. That Act established a comprehensive research program to investigate the causes and effects of acid deposition, and reflected Congress' judgment that acid rain related regulatory programs should *not* be undertaken until the extensive investigation of the phenomenon authorized by the Act (and now underway) has been conducted.[2] In sponsoring the legislation that led to the passage of the Acid Precipitation Act, Senator Moynihan underscored Congress' concern that premature action could prove disastrous:

> [T]he Senate is proposing to learn something about the subject *before* it mandates solutions. It will be possible to make profoundly gross mistakes here if we do not do some research *first*, mistakes that would cost billions.[3]

Since 1980, no new evidence has emerged that justifies rejecting the reasoned approach adopted by Congress and underscored by Senator Moynihan.

The most disturbing aspect of H.R. 5555 is its failure to address a host of critically important scientific and policy questions that must be resolved before intelligent conclusions can be drawn concerning the *need* for any acid rain regulatory program. The following discussion *briefly* notes several of the more pressing of these questions and indicates why we believe that the emission reduction scheme contained in H.R. 5555 is totally unjustified.

1. *Are significant, adverse effects occurring as a result of ecosystem acidification?*

At present it is not at all clear that significant environmental damage is being caused by ecosystem acidification. While certain sensitive[4] lakes and streams in the Northeast have apparently suffered as a result of acidification, no conclusive evidence exists to support the hypothesis that acid deposition has adversely affected forests,[5] soils,[6] crops,[7] or human health.[8]

2. *Is ecosystem acidification caused primarily by precipitation acidity?*

Although proponents of emission reductions routinely assume that precipitation acidity is primarily, if not exclusively, responsible for aquatic ecosystem acidification, the validity of this hypothesis has yet to be demonstrated. The aquatic ecosystems that have exhibited signs of acidification—primarily poorly buffered lakes and streams in the Northeast—are frequently exposed to a variety of acidifying influences, each of which may play a significant role in determining pH levels.[9]

3. *Would reductions in emissions significantly remedy the harm allegedly resulting from acid deposition?*

The most serious uncertainty associated with various emission reduction proposals is the enormous doubt as to whether such reductions would significantly alter the pH of distant rainfall. As Dr. Ralph Perhac of the Electric Power Research Institute (EPRI) has stated:

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[1] 42 U.S.C.A. 8901 et seq. (1980 pamphlet).

[2] Id. at § 8904(b). See Interagency Task Force on Acid Precipitation, "First Annual Report to the President and the Congress of the United Sates." (January 1982).

[3] 125 Cong. Rec. S16198, col. 2 (daily ed. Nov. 8, 1979) (emphasis added).

[4] As the Province of Ontario has noted, acidity "damages aquatic life in lakes and streams only in areas where there is very little capacity in the soils and rock to neutralize the acid." Ontario Ministry of the Environment, *The Case Against Acid Rain* 20 (October 1980).

[5] *See* National Council of the Paper Industry For Air and Stream Improvement, *Acidic Deposition and Its Effects on Forest Productivity* 40, 42, 58 (January 1981). As Senator Mitchell—sponsor of acid rain legislation in the Senate—has recognized, the conclusions voiced by paper company representatives carry special weight with respect to forest productivity, since a reduction in growth could seriously affect the industry. See 127 *Cong. Rec.* S9085, col. 1 (daily ed. July 31, 1981).

[6] Government Accounting Office, "The Debate Over Acid Precipitation:—Opposing Views—Status of Research", 8–10 (September 11, 1981) (hereinafter cited as GAO Report).

[7] ASL and Associates, *The Effects of Ozone/Oxidant and Acid Rain on Agricultural Crops* 3-2 (1981) (prepared for Congress' Office of Technology Assessment).

[8] GAO Report at 11–12.

[9] ALS Associates, *The Effects of Acid Rain on Terrestrial and Aquatic Ecosystems* (1981) at 3–11, 3–15.

> What if, for example, under some particular atomspheric condition only 20% of the sulfur in the air could get into rain drops? Under that situation, we could remove most of the sulfur and still have no effect on the acidity of the water . . . [U]ntil we know how acid rain actually forms . . . we will not know what effect increasing or decreasing powerplant emissions will have.[10]

The results of field research confirm the legitimacy of these concerns. Researchers at Rensselaer Polytechnic Institute have recently analyzed precipitation pH in the Adirondacks in an attempt to evaluate the relationships between rainfall acidity and concentrations of sulfates and nitrates in precipitation. Data collected over a three year period indicate that substantial changes in sulfate and nitrate levels have only modest impacts on pH—thus casting serious doubts as to whether dramatic reductions in anthropogenic SO_2 and NO_x *emissions* could significantly alter precipitation pH. In testimony prepared for House hearings on acid rain, Dr. Robert Brocksen of EPRI commented on the implications of the RPI study:

> Based upon this relationship [between precipitation pH and sulfate and nitrate levels], we can calculate the change in precipitation pH as a function of the change in sulfate and nitrate concentrations. We estimate that the precipitation *pH on the average will change from 4.2 to 4.5 if both the nitrate and sulfate concentrations are halved by some means. If sulfate alone is halved, the precipitation pH may, on the average, change from 4.2 to 4.4.* Another observation which can be made from RPI's data is that the snowfall samples contain much more nitric acid than sulfuric acid. Reduction of the sulfuric acid content alone may not change the snow acidity to any significant extent.[11]

The point is that at present we have no firm evidence that emission reductions will make rainfall less acidic or that they will have any significant affect on the process of aquatic acidification.

4. Would the prospective benefits of emission controls be overshadowed by the accompanying costs?

Even if there was sound evidence for concluding that emissions reductions would significantly reduce ecosystem acidification, a thorough evaluation of whether resulting environmental benefits outweighed the costs of those reductions would be necessary before any rational control decision could be made. The benefits of air pollution control cannot be considered in an economic vacuum. We believe that the environmental advantages of emission reductions beyond those necessary to attain the primary standards should be evaluated in light of attendant economic and energy costs.

5. Would emission reductions represent the most cost-effective mechanism for remedying the harm allegedly resulting from acid precipitation?

If an examination of costs and benefits were to reveal that a mitigation program were justified, one last critical threshold question would still have to be addressed before that regulatory program was devised—the issue of cost effectiveness. Before any emission reduction requirements are imposed alternative ameliorative measures should be explored in an effort to determine whether ecological impacts could be remedied through less expensive means. In light of our Nation's limited economic resources, it would make little sense to choose measures not destined to maximize the environmental benefits obtained from each dollar spent.[12]

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[10] Testimony of Dr. Ralph M. Perhac, Hearings on Acid Rain before the Subcommittee on Oversight and Investigations of the House Committee on Interstate and Foreign Commerce, 96th Cong. 2d Sess. 4-5 February 27, 1980.

Dr. Perhac's assessment of the difficulties involved in predicting the impact of emission reductions upon precipitation acidity is shared by Dr. Leonard Newman, an atmospheric scientist with Brookhaven National Laboratory. Dr. Newman recently concluded that:

> Since we have not identified the rate-limiting step in the incorporation of SO_2 into rain water, if that rate-limiting step is a catalyst (for example, carbon or a transition metal) then we might not reduce the amount of sulfate in the rainwater by simply reducing the amount of SO_2 in the air.

Newman, *Acid Rain and the Atlantic Salmon* 35 (paper delivered at conference sponsored by the International Salmon Foundation, November 22-23, 1980).

[11] Testimony of Dr. Robert Brocksen before the House Subcommittee on Health and Environment 12 (October 2, 1981) (emphasis added). Recent evidence has also challenged fundamental assumptions regarding the influence of long range transport. Studies conducted by researchers in the U.S. and Canada suggest that local sources may play a far more important role in sulfate formation than has previously been thought. *See* Shaw, *Deposition of Atmospheric Acid from Local and Distant Sources at a Rural Site in Nova Scotia*, 16 Atmos. Env't. 337 (1981); Rahn, *Elemental Tracers and Sources of Acidity for the Northeast—A Statement of New Evidence*, (November 1981).

II. SECTION-BY-SECTION ANALYSIS OF H.R. 5555

H.R. 5555 would effectively impose a moratorium on increases of sulfur dioxide (SO_2) emissions in a 31 state region, and require a 10,000,000 ton reduction in SO_2 emissions in that region within ten years after enactment.[13] We believe these requirements are premature, irrational and punitive. They are premature because, as discussed previously, there is no firm evidence that they are necessary or that they will result in any significant environmental benefit. They are irrational because they would impose deadlines which obviously cannot be met and because they fail to allow any examination of the need for emission reductions prior to their implementation. They are punitive because they tend to single out the utility industry specifically and the Midwest in general and impose on them truly enormous costs.

Among the specific issues raised by H.R. 5555 are seven that we find especially troubling: (1) the arbitrary nature of the *de facto* moratorium on emission increases and the 10,000,000 ton rollback requirement; (2) the enormous economic, employment and energy impacts of the bill; (3) the unreasonableness of the procedures to be followed in the event states fail to submit an emission reduction plan (or EPA fails to act upon the plans) within the time allotted; (4) the treatment accorded sources not yet in operation and sources seeking to convert to coal; (5) the unnecessary restraints imposed by the bill on the flexibility states would be allowed in determining how to achieve emission reductions; (6) the inequitable nature of the emission reduction burden thrust upon the electric utility industry; and (7) the failure of the bill to address how installation of equipment necessary to comply with the required emissions reductions will be financed.

A. The Identification of Acid Deposition Impact Regions

Section 181 of the Waxman bill creates an acid precipitation impact region comprised of the 31 states which border on or are east of the Mississippi River, and the District of Columbia. It also requires EPA to determine whether additional impact regions should be established throughout the remainder of the country.

In drawing the geographic boundaries of any impact region, two considerations should be kept in mind. First, the stringent emission reduction requirements imposed by H.R. 5555 could dramatically affect the operations of any source in the 31 state impact region. Yet, despite the importance that the bill attaches to a state's inclusion in or exclusion from the region, the legislation designates the region through legislative fiat, rather than providing for a state-by-state evaluation of the necessity for impact region coverage. We believe that any legislation should direct EPA to consider the issue through informal rulemaking to ensure that the borders of the initial region (and subsequent regions, if any) are properly drawn. The bill could easily accomplish this by granting EPA authority to devise the initial region pursuant to the rulemaking provisions of § 307(d) of the Clean Air Act.[14]

Second, H.R. 5555 currently provides no guidance as to the criteria that should govern an impact area designation. If EPA is granted the authority to create such regions, Congress should establish substantive criteria[15] to be considered by EPA in determining whether designation is warranted.

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[12] A recent analysis of lake acidification in Europe suggests that mitigation measures aimed directly at lake pH—such as the addition of alkaline material—could constitute a potentially far more cost-effective strategy than the imposition of emission control requirements. *See* Barnes, *Acid Rain—An International Concern*, 30 J. Air Pollution Control Ass'n., 1089 (1980). Experimental liming programs undertaken by New York State and Ontario confirm the potential success of such an approach. *See*, Ember, *Acid Pollutants; Hitchhikers Ride the Wind*, 59 Chem. & Engineering News 22 (September 14, 1981) (statement of New York State biologist Martin Pfeiffer); *Ontario Report*, *supra* note 7 at 22. The results of studies conducted in Ontario are particularly enlightening. After reviewing the impact of a liming program instituted at an acidified lake north of Sudbury, the Province of Ontario has concluded that:

> [t]he pH was restored to normal over a two-year period of time . . . [and] indications are that the treatment will be successful in restoration of the fishery. Therefore, the results of some experiments are making biologists more optimistic about liming programs.

Id. at 22.

[13] The bill mirrors acid rain legislation introduced by Representative Moffett (H.R. 4829) and is substantially similar to emission reduction legislation that has been introduced by Senator Mitchell (S. 1706).

[14] By retaining power over the designation of additional regions, Congress could examine the propriety of EPA action in developing the initial region and, if necessary, establish remaining regions through legislative action.

[15] The criteria could require examination of data relating to current levels of precipitation pH, projected emission trends, buffering capacity of ecosystems in the prospective region, etc.

B. The Imposition of a De Facto Moratorium on Increases in SO_2 Emissions

1. The de facto moratorium

In contrast to Senator Mitchell's bill, H.R. 5555 does not impose an ***immediate, source-specific*** cap on sulfur dioxide and nitrogen oxide emission increases in the impact region. However the language chosen by the bill's author to establish the 10,000,000 reduction obligation effectively require that any regional increases in SO_2 must offset within ten years after enactment. The bill therefore *does* in effect impose a *de facto* moratorium on emission increases throughout the impact region. As a result, increases from new source operations, coal conversions, production increases and SIP revisions would generally be considered "suspect," since the increases would add to the region's 10,000,000 ton reduction requirement and force state officials to impose even harsher statewide rollback measures. Mindful of the offset obligation looming ahead, state officials would likely impose source-specific caps akin to those required in the Mitchell bill.

2. The effective date of the moratorium

The Waxman bill adopts a curious approach with respect to the implementation of the 10,000,000 ton reduction—and hence the *de facto* moratorium—requirement. Instead of applying §183(a) as of the date of enactment, the bill in effect provides that the measure would be deemed *retroactive* to January 1, 1981. As a result states would be required to offset all increases that have occurred *since 1980,* not merely those that occur after enactment.

3. The impact of the moratorium

The offset obligation implicit in the bill's 10,000,000 ton reduction requirement could create considerable problems for states seeking to encourage new industrial development or lessen existing sources' dependence upon imported oil and natural gas. In areas where offsets are unavailable[16] or prohibitively expensive, new source construction and coal conversions be substantially inhibited, and in certain cases, prohibited altogether.

The discouragement of new source construction makes little sense in light of the fact that major new sources (1) are subject to stringent emission limitations, (2) enable owners to increase productivity and energy efficiency, and (3) could ameliorate unemployment problems in economically distressed areas of the Northest and Midwest. We believe new sources should be exempt from any moratorium on emissions increases.

The moratorium similarly places significant restraints upon utilities planning to convert to coal as a means of reducing foreign oil consumption. As with sources not yet in operation, prospective conversions resulting in emission increases would not be allowed unless offsets were available. Since the 10,000,000 ton reduction requirement would leave offsets in very short supply, conversions could prove economically infeasible, and in certain cases would be effectively precluded. The moratorium could prove particularly devastating to ratepayers that have had to pay the costs of emission reductions achieved through reliance upon low sulfur oil. Utilities in the Northeast that are attempting to convert to coal in response to ratepayer's needs and national energy policies may find it particularly difficult to do so as a result of the moratorium, since the potential for intra-source offsets in states such as Vermont, New Hampshire, Maine, Rhode Island, and Connecticut is quite limited.

In light of the regional economic and national energy considerations that militate strongly in favor of oil reduction, we recommend that the bill exempt coal conversions from the moratorium.

C. The 10 Million Ton Sulfur Dioxide Emission Reduction

1. The nature and origin of the reduction requirement

In view of the extraordinary magnitude of the emission reduction requirement imposed by H.R. 5555, compelling justifications should exist to support its imposition. Yet when asked recently the basis for the 10,000,000 ton reduction required under the legislation he has introduced, Senator Mitchell candidly acknowledged that it was "*arbitrarily*" chosen.[17] The "Press Statement" accompanying Representative Waxman's bill suggests that the National Academy of Science's recent examination of acid deposition provides support for the 10 million ton reduction. Yet, as Dr. Volker Mohnen has observed, reliance upon the NAS study to justify a substantial emission reduction program is misplaced:

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[16] The obligation could pose particularly severe problems for source owners who do not have a ready supply of intra-source offsets. Evidence compiled by the National Commission on Air Quality (NCAQ) indicates that inter-source offsets are already in short supply—a situation that could only be exacerbated by the bill's unprecedented emission reduction requirement. The Commission concluded that "[t]here is substantial evidence that sources that must obtain offsets from other companies will *not generally be able to acquire them*" in the absence of local or state government intervention. The National Commission on Air Quality, *To Breathe Clean Air,* 3.4–47 (1981) (emphasis added).

> [T]he hypothesis that reductions in SO_2 emissions from distant sources in the Midwest will decrease acid rain in the Northwest is not supported by the *scientific* research that has been conducted on acid rain. Based on our limited present understanding of acid rain, it is impossible to predict the changes, if any, in wet and dry deposition that the emission reductions that would be required by this bill would have in the environmentally sensitive areas of the northeast.
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> In light of what I have said, I am surprised to observe that many persons appear to believe that the control strategy required by S. 1706 is adequately supported by science. A study relied upon by some as support for S. 1706 is the recent report of the National Academy of Science. . . . That report concludes (on page 181) that control of SO_2 and NO_x emissions "can significantly reduce the rate of deterioration of sensitive freshwater ecosystems," that it is desirable for such areas to have pH values no lower than 4.6–6.7, and that in the most seriously affected areas "this would mean a reduction of 50 percent in deposited hydrogen ions." Because I am not an expert on the ecological effects of acid rain, I am in no position to comment on whether the ecological damage caused by acid rain justifies the report's recommendations of a 50 percent reduction in deposited hydrogen ions for those areas most seriously affected. However, I have shown in this statement that it is wholly erroneous to assume, as S. 1706 appears to do, that a reduction in SO_2 emissions of 50 percent or 10 million tons will yield a reduction of 50 percent in deposited hydrogen ions.[18]

In light of our present inability to relate changes in precipitation chemistry to emission reductions it is not surprising—although certainly disturbing—that the central regulatory requirements of the Mitchell and Waxman bills are premised upon nonexistent or wholly inadequate scientific foundations. As EEI has repeatedly emphasized throughout the acid rain debate, it defies logic to mandate emission reductions without a clear understanding of what the benefits of such requirements would be.

2. The costs of the reduction requirement

Although compliance with the Waxman bill's 10,000,000 ton of SO_2 reduction requirement would be extraordinarily expensive, the bill offers little indication that those costs were seriously considered. Preliminary economic analyses of the Mitchell bill indicate that it would cost utility ratepayers and shareholders approximately *$7 billion annually* by 1990, and require total capital expenditures of $26 billion between 1982 and 1990.[19]

3. The impact of the bill upon coal production in economically distressed areas

In large areas of the Midwest and Appalachia, coal mining is an essential component of a healthy economy. During the past decade the demand for high sulfur coal has declined, relative to low sulfur coal, and as a result, certain areas within the region have experienced severe economic dislocation and unusually high unemployment. Representative Waxman's bill will exacerbate these problems. Under Senator Mitchell's substantially similar scheme, for example, Midwestern coal production in 1990 would drop by approximately 35% from levels that would otherwise be achieved. Coal production in Northern Appalachia would also decline significantly.[20]

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[17] Testimony of Senator George Mitchell in Hearings on Acid Rain Before the Subcommittee on Health and Environment of the House Energy and Commerce Committee (October 20, 1981) (transcript at p. 23).

[18] Testimony of Dr. Volker Mohnen, Director, Atmospheric Science Research Center; State University of New York at Albany before the Senate Committee on Environment and Public Works 3, 26–27 (November 5, 1981).

[19] ICF Inc., "Summary of Preliminary Analysis of the Costs and Coal Production Impacts of the Mitchell Bill." Table 1 (January 25, 1982 Draft). While the terms of the Waxman and Mitchell bills differ slightly, it is unlikely that aggregate compliance costs for each would differ significantly.

[20] ICF Report, *supra* note 19 at Table 1.

D. Calculation of Emission Reduction Requirements

1. Failure to consider non-utility emissions

Section 183(c) of the Waxman bill provides that only *utility* emissions are to be counted in compiling the region's emission inventory and in calculating the states' rollback requirements. In effect the legislation abandons any attempt to apportion emission reduction requirements equitably among the affected states, and instead provides a windfall to states whose SO_2 emissions are not emitted by *utilities.* States in which SO_2 emissions are produced by industrial, commercial and residential boilers would not be required to reduce emissions in an amount proportional to their contribution to regional SO_2 loading. In Maine, for example, annual SO_2 emissions from industrial, commercial and residential fuel combustion are far higher (approximately 46,000 tons) than the state's annual utility SO_2 emissions (approximately 10,000 tons). Yet only the utility emissions would be counted in determining emissions reduction requirements.

E. State Implementation Plan Requirements

1. The inclusions of emission reduction requirements in SIPs

Under § 184 of the Waxman bill, source-specific emission reductions must be included in state implementation plans. EPA therefore must initially review the adequacy of each rollback plan, and pursuant to section 110(a)(3)(A) of the Act subsequently approve any changes sought by individual sources.

We are concerned that the traditional source-specific SIP revisions review required by section 110 could create unnecessary hurdles for sources after they have complied with reductions imposed as a result of the legislation. The procedural delays incident to EPA review could, for example, seriously interfere with source owners' efforts to realign emission reduction responsibilities and take advantage of inter-source disparities in emission reduction costs. We therefore recommend that where EPA has approved a state's rollback program, inter-source trades should be exempted from EPA review if net emissions will not increase.

2. EPA review of state emission reduction

Representative Waxman's bill allows EPA only four months in which to review the adequacy of state emission reduction plans. Yet EPA efforts to comply with the four month deadline would almost inevitably prove futile, since the Agency's simultaneous review of the 31 state plans would require informal rulemaking—a proceeding that typically lasts far longer than four months—involving the resolution of complex factual and novel legal issues. At a minimum, the process would entail (1) an evaluation of the adequacy of each state's rollback plan; (2) the formulation of a preliminary decision to approve or disapprove the plan; (3) *Federal Register* publication of the proposed rule and solicitation of public comments; (4) an analysis of significant comments and preparation of responses thereto; and (5) formulation of a final decision on the SIP, including the incorporation of any revisions necessitated by public comments.

If the bill attached no practical significance to the Agency's failure to meet the four month deadline, concerns regarding the reasonableness of the review period would be largely academic. Unfortunately, however, EPA's failure to comply with the timetable could spawn a series of citizen suits and seriously handicap the Agency's ability to conduct its other business.

By providing that the Agency "shall" conduct its review within four months, the legislation would arguably impose a mandatory duty upon EPA. Under section 304 of the Act, the Agency's failure to perform a non-discretionary duty—notwithstanding its apparent impracticability—constitutes grounds for citizen suit litigation. Thus if the bill were enacted, EPA could conceivably become embroiled in litigation whenever it failed to comply with the four month deadline.[21] We recommend that any legislation recognize the limited nature of EPA's resources and avoid establishing timetables destined to provoke litigation and trigger statutorily imposed emission reduction requirements.

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[21] Environmental groups have demonstrated little reticence in seeking judicial sanctions aimed at requiring EPA to comply with statutory deadlines—however unrealistic. See, e.g., *Sierra Club* v. *Gorsuch*, No. 81–0094 (D.D.C. filed Jan. 14, 1981) (designed to force EPA to promulgate stack height regulations); *Sierra Club* v. *Gorsuch*, No. 81–2436 (N.D. Cal. filed June 16, 1981) (designed to force EPA to issue hazardous pollutant regulations for radionuclides); *Friends of the Earth* v. *Costle*, No. 79–2311 (D.D.C. November 5, 1979) (aimed at requiring promulgation of final visibility protection rules).

F. Federally Imposed Emission Limitations

1. The statutory imposition of system-specific emission limitations

Sources located in states that fail to devise emission reduction plans or that fail to receive expeditious EPA approval of the plan receive harsh treatment under section 185 of the bill. If a state fails to submit a rollback plan within two years after enactment, or if EPA neglects to act upon the plan within 2 years and 4 months after passage, all utilities within the state will be required to comply with a system-wide 1.2 lbs./MBtu average emission rate. The federal emission limitation philosophy embodied by section 185 represents an unjustifiably punitive and potentially far more expensive approach than even that embodied by the bill's 10 million ton rollback program. We believe it should be eliminated from any consideration by this Committee.

a. Targeting of the utility industry

If state plans are not submitted or approved within the tight deadlines provided, the bill inexplicably requires that the entire emission reduction burden be imposed upon electric generating facilities. We object to this clearly discriminatory treatment of utilities and utility ratepayers. First, the singling out of the electric utility industry constitutes a repudiation of the bill's central premise that SO_2 reductions are essentially fungible, and that costs of control should therefore be minimized whenever possible. Section 184 instead imposes reduction obligations in a manner that ignores the economies that could be achieved by a broader apportionment of the reduction obligation. Second, the bill provides nonutility emitters with an extraordinary windfall—a complete exemption from any emission reduction requirement—whenever the state or EPA fails to comply with the patently unrealistic schedule set forth in § 184.

b. Let the punishment fit the crime

The uniform emission standard approach evokes serious concerns apart from its inherently discriminatory nature and its assault upon the principles of flexibility and cost-effectiveness. In a curious juxtaposition of crime and punishment, the ceiling imposes a severe penalty upon the *utility industry* in retaliation for actions or lack thereof of *state or federal officials*. Instead of instituting measures designed to address the failure of such officials to act, the bill radically restructures the reduction requirement by substantially restricting the emission control measures that may be instituted.

We strongly recommend that this illogical approach be abandoned, and that any legislation contain the approach Congress has already embraced in combating analogous state inaction under § 110(c)(1) of the Act. Essentially that section authorizes *EPA* to prepare state plans to ensure compliance with the ambient standards if states themselves fail to devise SIP provisions, and through §§ 304 and 307, allows citizens to intervene if EPA action is inadequate. In the same manner, the Waxman bill should simply allow EPA to carry on in the state's stead if the state fails to act. [22] EPA could then formulate SIP provisions consistent with the state's required reduction—after conducting hearings as required under § 110(c)(1)(C)—in a manner designed to minimize emission control costs and preserve emission reduction alternatives.[23]

G. Inter-Pollutant Emission Reduction Exchange

1. The substitution concept and the reduction ratio

We support the NO_x for SO_2 substitution concept embraced by section 184(d). Although we disagree with the premise that additional emission controls should be imposed, we believe that if any legislation calling for emissions reductions is enacted, decreases in SO_2 and NO_x should be treated interchangeably.

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[22] Senator Moynihan's bill essentially adopts such an approach. See S. 1709 at § 185(a)(2), 127 Cong. Rec. S11158, col. 1 (daily ed. October 6, 1981).

[23] The bill's apparent animus toward the utility industry is again reflected in § 185(c). If for any reason a utility company fails to submit a plan (within 8 months) to achieve the 1.2 lb. systemwide limit, or receive EPA approval of its plan, the bill imposes a 1.2 lb. unit-specific cap that must be achieved within five years after enactment. Rather than penalizing the industry for EPA's shortcomings or a simple delay in the submission of a § 185(c) plan, the bill should authorize EPA to devise a program to ensure compliance with the systemwide limit or, preferably, the source's share of statewide emission reductions required to comply with § 184.

We do *not* subscribe to the view that the NO_x/SO_2 reduction ratio must exceed one. The bill offers no evidence to support its implicit assertion that NO_x reductions should be viewed as less valuable than SO_2 reductions. Yet the rejection of equivalency would clearly skew control efforts towards sulfur dioxide, thereby interfering with sources' efforts to minimize control costs through reliance upon NO_x reduction measures.

2. *Mobile source emission reduction credit*

It is not clear whether the bill, in providing credit for NO_x emission reductions, requires that only decreases from stationary sources may be counted. As a result, it is unclear whether reductions achieved through compliance with mobile source controls may be relied upon by States in partial fulfillment of the bill's offset and emission reduction requirements.

We do not believe that credit should hinge upon the origin of the emission reduction. States whose citizens are forced to underwrite the costs of emission reductions—whether from mobile or stationary sources—should be entitled to credit. The manner in which reductions are achieved is irrelevant; in either event total loading would decline and the purposes of the bill would be served.

H. Sharing the Costs of Reductions

In analyzing the Waxman bill, we have focused our attention upon two major issues: first, the advisability of enacting any emission control program, and second, the feasibility of the specific requirements established in the bill. If Congress does ultimately decide to enact emission control measures, a third key question will arise: how should the costs of control be apportioned? Although the legislation does not address the "who pays" issue, we believe that it must be considered in conjunction with any substantial emission reduction proposal.

Even if one is willing to assume that controls are warranted, it hardly seems equitable to inflict the costs of an emission reduction program upon sources that are located in states destined to obtain relatively little of the benefits that will allegedly result from the required reductions. In light of this inherent inequity, we recommend that any acid rain legislation enacted by Congress address the issue of how the affected sources would raise the funds necessary to pay for pollution control equipment required to meet emission reduction requirements and how the costs of raising those funds could be borne at least in part by those who will supposedly reap benefits.

COMMENTS ON ATMOSPHERE-BIOSPHERE INTERACTIONS: TOWARD A BETTER UNDERSTANDING OF THE ECOLOGICAL CONSEQUENCES OF FOSSIL FUEL COMBUSTION

1. INTRODUCTION

The report entitled "Atmosphere Biosphere Interactions" was prepared by the Committee on the Atmosphere and Biosphere, Board on Agriculture and Renewable Resources, Commission on Natural Resources of the National Research Council. The National Research Council (NRC) is the principal operating agency of the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine. The Commission on Natural Resources is one of eight major permanent units within NRC, and undertakes study and review projects in response to specific requests from the government and other organizations as called for in the Congressional Charter to the Academy.

These projects are conducted by four boards, including the Board of Agriculture and Renewable Resources, which serves as a focus for identifying national needs and promoting activities in the broad areas of agriculture, land and water use, forestry, wildlife and fisheries, agriculture, rangeland management and rural development. In turn, each board carries out specific projects through short-term committees. Appointments to these committees are made after a careful process of search and selection among scientists from academic, industry, government, and other sectors of society.

The Committee on the Atmosphere and the Biosphere was assembled in 1980. The charge of the committee included the preparation of a report that examines the exchange of substances between the atmosphere and the biosphere, the processes by which these exchanges occur, and the biological consequences of such exchanges, with emphasis on the nature and magnitude of man-induced alterations of the natural cycling of matter between the atmosphere and biosphere and on the ecological impact, favorable as well as unfavorable, of these alterations. The study was funded by NRC contracts with the U.S. EPA, the Forest Service of the U.S. Department of Agriculture, and the Fish and Wildlife Service and National Park Service of the U.S. Department of the Interior.

The report was prepared in final draft form in January 1981, at which time each committee member was given the opportunity to approve or disapprove the draft and/or specific portions of it. The draft was then released for review by the Report Review Committee of the Academy and by outside reviewers. Comments (generally favorable as stated by the NRC project officer) were received from a total of 11 appointed reviewers, and text changes were made when appropriate in response to reviewer comments. The final report was submitted to the National Academy Press in July 1981 for printing.

Environmental Research & Technology, Inc. (ERT), was asked by the Utility Air Regulatory Group to critically review those sections of the report dealing with acid precipitation for objective balance and for accuracy in presenting the current state of our knowledge regarding this topic. Thus, most of the comments which follow address the material appearing in Chapter 8 of the report.

Initially, we present some general comments. These are followed by specific comments on the contents of Chapter 8.

2. GENERAL COMMENTS

The greatest strengths of the report are (1) the overview that is presented on man's historical and current potential for altering ecosystem dynamics, and (2) identification of areas for research to increase our understanding of how anthropogenic emissions released into the atmosphere actually impact ecosystems. The most readily apparent weaknesses of the report are (1) emphasis on speculative adverse effects unsupported by firm data, and (2) selectivity in the presentation of information.

For example, many predictions are made which "can," "may", or "are likely" to occur based on very preliminary information. The statement is even made that our decendents will suffer food shortages only if we decrease our reliance on fossil fuels. Yet no information is given in the report to support this claim. We understand that predictions can never be expected to be perfect, but predictions based on inadequate or conflicting data are irresponsible. Specific examples supporting this viewpoint are given in Section 3.

With regard to selectivity in the choice of information given, certain key generalizations can be made. Power plants are repeatedly singled out as the sources which require controls, whereas any equitable distribution of control costs would have to be applied across the spectrum of sources which emit acid precursors. When amelioration of effects is discussed, only one option is considered to be practical, i.e., control of emissions. Relative costs and benefits of available options are not considered. Studies showing the adverse effects alleged to be caused by acid precipitation are highlighted while studies showing no or beneficial effects are brushed aside. Generalizations of widespread adverse effects are made when the supporting information given deals with a particular extreme case such as exists in the vicinity of the Sudbury smelter complex.

A particularly onerous example of presenting information to support an argument when the support is only superficial is represented by the use of Figure 8.1. This figure ostensibly shows a close correspondence between thermal energy production and sulfate concentrations in Greenland glacier samples, i.e., when energy production went up, so did sulfate. What the author doesn't bring to the attention of the reader is that all the high sulfate samples were collected over a nine-month period shortly after a major volcanic eruption and demonstrate no trend relatable to energy production but essentially a transient short-term increase (with a high degree of variability during the measurement period).

This and other examples of some of our concerns about the manner that information is presented in Chapter 8 are discussed in the following section.

3. SPECIFIC COMMENTS ON CHAPTER 8

Man's fuel use has not caused global pollution which has existed for centuries

In the discussion of the causes of acid precipitation, it is claimed that, in theory, rain pH should be determined by the contributions from dissolved CO_2, alkaline dust, and ocean spray. It is then claimed that this theory is no longer testable because the combustion of fossil fuels and smelting has caused global pollution which has existed for "decades, if not centuries." Figure 8.1 is then offered to support this claim. Can the sulfate values measured around 1300 AD, which are approximately the same as those from 1920 to 1930, honestly be attributed to anthropogenic sources? Obviously not. The high values reported for the 1964 to 1965 Patterson samples are shown without pointing out that they may well have been elevated by the major eruption of the volcano Agung in 1963. A similar peak in sulfate was observed in Antarctic snows (Delmas et al. 1980) in 1964 to 1965. Thus, the above claim is seen to be not supported by the figure. In fact, paleoclimatologists have established what the background acidity of polar ice caps is (Hammer et al. 1980, Delmas et al. 1980) and observe no recent increase. It can only be concluded that the author's claim and the figure chosen are unrepresentative of the prevailing body of relevant information.

Anthropogenic sources are not the only plausible explanation for acid deposition

On page 142, it is stated that "increased emission of sulfur and nitrogen compounds from anthropogenic sources is the only plausible explanation for acid deposition." Yet the author has previously stated that "small releases of sulfur and nitrogen oxides from volcanic activity and microbial metabolism to the biosphere would cause slightly lower natural pH levels . . ." These statements are inconsistent. Moreover, the author's choice of the words "small" and "slightly" are prejudicial because natural sources of the precursors of atmospheric sulfuric acid are not small and the pH of rainfall in many remote areas (Amazon basin, Indian Ocean, Hawaii, e.g.) is not slightly lower, but significantly lower, than 5.6 (see Cullis and Hirschler 1980 and Kerr 1981). Thus, it is seen that there are other plausible explanations for acid deposition than the one cited by the author. Anthropogenic emissions are *one category* of contributors to acid deposition.

Firm evidence is not available to show global or U.S. increases in rainfall acidity

The citation of Hansen et al. (1981), in the discussion of changes in precipitation acidity, misstates the conclusions reached by these authors. Hansen et al. concluded that the existing data base is inadequate in quantity and quality to support an interpretation of a trend toward increasing rainfall acidity in the eastern United States over the past 25 years. They pointed out that climatological changes may have affected precipitation pH changes between 1955 to 1956 and the present much more strongly than changes in emission. Figure 8.1 is referred to again on page 142 to support increased sulfate deposition during the twentieth century in remote regions. We have already pointed out some of the deficiencies in Figure 8.1. An additional point that should be made is that the Patterson samples were taken over a nine-month period in 1964 to 1965. Thus, the points do not show a rising trend in sulfate, as might be inferred from the figure, but show the variability which occurred over the nine-month period. This is an example of the misuse of statistical data to support an argument.

Emissions from tall stacks do not necessarily increase the efficiency of acid precipitation formation

The last two paragraphs on page 142 demonstrate a misunderstanding of the relative importance of the mechanisms that contribute to the formation of atmospheric sulfuric acid. Firstly, acid precipitation is not produced "more eficiently" by having emissions injected at higher elevations. Certainly, homogeneous gas phase reactions (primarily initiated by reaction with hydroxyl radical) converting SO_2 to $SO^{=}_4$ have a greater opportunity to go to completion before removal of the sulfur species when the SO_2 is higher in the atmosphere. But the "efficiency" of acid precipitation formation is often controlled by aqueous phase reactions on aerosol droplets and in the precipitation itself. The best example supporting the importance of aqueous phase reactions over gas phase conversion of SO_2 and $SO^{=}_4$ may be the work of R. A. Smith (1872) who showed that the level of sulfuric acid in rain near cities in England (i.e., near the sources of SO_2) was 10 to 30 times higher than at "country places." Obviously, a very efficient conversion of SO_2 to $SO^{=}_4$ can take place locally without the intervention of tall stacks and where photochemical reactivity is low.

The references cited do not support the conclusions drawn

On page 147, in the discussion of land-use patterns on lake acidification, it is stated that "studies of lakes in North America . . . have also shown substantial increases in hydrogen ion or losses in buffering capacity." Dillon et al. (1978) is one of the two references cited. Dillon et al. had prior data for only 3 of the 15 lakes studied. Two of the three showed *no* change in alkalinity between the measurements. The remaining lake, Walker Lake, was previously sampled on one day in 1971. The alkalinity measured was $\sim 400\ \mu eq/l$. In 1974 the alkalinity was measured to be $\sim 180\ \mu eq/l$. Since the other two lakes, having similar alkalinity to that of Walker Lake, showed no such precipitous changes, we question the validity of the data for Walker Lake. In addition, Dillon et al. report data taken by Schindler and Nighswander in 1967 for Clear Lake which indicated an inflection point alkalinity of 33 μeq/*l*. This is compared with Dillon's measurements in 1977 for Clear Lake of 2 to 15 μeq/*l*. We doubt very seriously whether these values can be considered to be different within the precision of the measurement method. It is also doubtful if these differences fall outside the natural range of variability for Clear Lake. Yet, it was on the basis of these questionable data for two lakes that Dillon et al. is cited. Use of literature references in this manner, without qualifications, does not give an accurate picture of our understanding of lake acidification in North America.

Confusion about the role of ammonia

We are confused by the author's discussion of nitrification on pages 147 and 149. Is atmospheric ammonia a threat to ecosystems because of its potential for acidification? Are we to understand that equal equivalents of ammonia and nitrate in rainfall (e.g., as NH_4NO_3) has no potential for acidification since that potential is "measured by the difference of ammonia and nitrate in equivalents?" Why is Figure 8.6 used to show "very high concentrations of ammonia in precipitation over the central United States" when much higher concentrations are shown for southeastern Canada? What is the relevance of these high central U.S. concentrations, since the soils in that area are highly managed and not sensitive to acidification? These questions should be addressed so that we better understand the significance of ammonia to the overall problem of ecosystem acidification.

The extent of the problem is not described

The paragraph entitled "Extent of the Problem" on page 149 is very misleading. Although it says that where poorly buffered "areas occur within several hundred kilometers of sources of atmospheric emissions that are acid precursors, detectable acidification . . . may be expected to occur," it ends by stating that 50 to 80% of the world's freshwaters occur in such terrain. The implication is that 50 to 80% of the world's freshwaters are threatened with acidification. If such an implication was unintended, it should be clarified to point out that considerably less than 1% of the world's freshwaters are so threatened by acidification as a result of *anthropogenic emissions* in the foreseeable future. The paragraph does *not* describe the *extent of the problem*. It describes the coincidence of freshwaters with poorly buffered geologic materials.

Long-term precipitation acidity changes can only be speculated upon

On page 152 the author refers a 10- to 40-fold enhancement of hydrogen ion in current precipitation. He states neither where nor enhanced over what. Presumably he means in the eastern U.S. and enhanced over the concentration in rainfall with a pH of 5.6. An interesting point is that we don't know what the pH of rainfall in the eastern U.S. would be in the absence of anthropogenic emissions. No such actual measurement data exist. It might be pH 6.3 due to the entrainment of soil dust in air masses passing from west to east over the continental U.S. It might be much lower due to washout and rainout of alkaline material before air masses pass over the east and incorporation of natural background sulfuric acid into the precipitation. We wonder how close to "natural" was the pH of precipitation at Windsor, Connecticut, over the period 1929 to 1948, which was apparently fairly constant and inferred to be 4.2 (Frink and Voigt 1977). Therefore, the presumed 10- to 40-fold enhancement is pure speculation.

More lack of support for conclusions from cited references

In the same paragraph the author states that "substantial changes (in the rate of acidification) are notable within a decade or decades." No data are given to support this allegation until the next paragraph when he cites the work of Dillon et al. (1978) again. Here he states that the Dillon study found "two lakes in south central Ontario . . . 'which' . . . had lost over 50% of their alkalinity in a period of 5 to 10 years." Our reservations about the interpretation of the Dillon et al. article have been described earlier and we find it unfortunate that the author has chosen it as the sole support for his allegation of decreasing alkalinity in North American lakes.

Generalizations are made from specific extreme examples

In discussing pH changes in lakes on page 152, the author highlights the studies of the Ontario Ministry of the Environment (1978) and Harvey (1980) to show "moderate to substantial decreases in pH over periods of a few years to two decades." What he doesn't point out is that the lakes studies were heavily influenced by emissions from the Sudbury smelter complex and, as such, are hardly representative of typical lakes in sensitive areas in North America.

Use of acidification indices may be premature

On page 153 it is claimed that "there is little double that the index (Henriksen's ratio of pH to calcium) is a reliable indicator of damage due to acidification where noncalcareous bedrock and soils predominate." We feel that this claim is premature, and needs to be tested for areas other than the five shown in Figure 8.8. For example, from recent water quality data taken by Welch and Chamberlain (1981) for 17 lakes in the Olympic National Park, upwind of any significant pollution sources, the average index falls above Henriksen's empirical line. All lakes are located in igneous or granitic rock basins. It is inconceivable that the index indicates acidification damage in this case that can be related to anthropogenic emissions. In the third paragraph on page 153, the author states that there is a consensus of opinion that the acidification of sensitive waters is detectable over short time scales. Again he relies heavily on studies of lakes influenced by the Sudbury smelter complex (Keller et al. 1980) and the article by Dillon et al. (1978). In citing the study of Thompson et al. (1980), he fails to point out that these authors reported an *increase* in pH in the rivers studied since 1973. The citation to Van Dam et al. (1980) is inappropriate since these authors provided no data supporting acidification of lakes but reported on the response of diatoms to acidification.

Natural cycles are ignored

There is an unfortunate omission on the author's part in his discussion of "chemical changes." He never considers the possibility that clear water lakes and bog lakes may undergo a natural evolutionary process of acidification. All changes are attributed to atmospheric inputs of acid deposition. For example, Vangenechten and Vanderborght (1980), whom he cites, at least consider the possibility that the oxidation of biogenically produced reduced sulfur compounds can contribute to the acidification of the bog lakes they studied. Such an omission by the author yields an unbalanced picture of the processes at work.

Contradictory evidence for mobilization of heavy metals is unresolved

On page 157 the author gives an oversimplified, if somewhat naive, description of the mobilization of heavy metals. He cites Troutman and Peters (1980) as supporting his claim that heavy metals (including cadmium and lead) "appear to be washed into lakes and streams from acidifying terrestrial systems." Yet he ignores their suggestion "that differences in lead accumulation and transport among lake watersheds are not related to lake outflow pH; they are instead hypothesized to result from differences in basin hydrology and ground water flux." In fact, he quotes Shindler et al. (1980) as finding that cadmium and lead "were not released by sediments at pH values down to 5.1 . . . " in seeming contradiction to his claim.

Speculation on long-term adverse effects upon forests is unsupported

The first paragraph of the section entitled "Terrestrial Ecosystems" starts out by admitting difficulty in assessing the effect of acid precipitation on forest yield. It then cites evidence for a fertilizing effect of acid precipitation, but labels such an effect "short term." Since there is no evidence that such effects are, indeed, "short term" the author then speculates on long-term adverse effects, apparently to strengthen his argument that beneficial effects must be short term. We note that *no firm evidence* is cited for his speculations on long-term effects. This approach by the author indicates prejudice toward the idea that all effects of acid precipitation must ultimately be adverse. In certain cases such a view may be warranted. However, the available evidence does not support such a view with respect to forest yield.

A fair picture of effects upon crops is not given

In the discussion of the effects of acid precipitation on crops, the author continues to stress the negative aspects of this topic. Examination of Tables 8.2 and 8.3 yields some interesting points the author apparently chose not to bring to the attention of the reader. Only under *greenhouse* conditions using simulated rain with a pH *less than 4.0* were adverse symptoms observed. With *field grown* crops, no effect or increased yield was observed for simulated rain having a pH of *3.0 or greater*. The additional point that should be stressed, is that actual rainfall having a pH of 3.0 or less occurs extremely infrequently and never over a widespread area. Therefore, the author emphasizes a situation that is not "rooted" in reality. Ironically enough, crops may be presently benefiting from acid precipitation in the eastern United States.

Nitrification is not adequately discussed

On page 176 to 179, the topics of nitrification and denitrification are again discussed. We feel that the rather confused presentation of these same topics on page 149 should have been combined in a more organized manner in this later portion of the chapter. By separating the two discussions, the fact that nitrification may be a self-limiting step (i.e., as hydrogen ions are released they slow down the nitrification) is lost. We also feel that, rather than simply referencing Mayer (1979) on page 149 as a source of information, the *author* should have "discussed the conditions under which natural acidification may be most significant." This would enhance our appreciation of the relative importance of acidification by acid precipitation versus that which occurs naturally.

Confusion regarding importance and sensitivity of bogs

The discussion of wetlands on page 180 is somewhat confusing. Disappearance of *sphagum* moss is initially attributed to atmospheric pollution (acid deposition?). Yet numerous studies (cited in Overrein et al. 1980) show *sphagnum* encroachment in acidified lakes. The author's point of view, regarding bogs as a threatened resource, is currently rather novel. Most of the relevant literature seen today expresses a rather different concern, i.e., that bogs may be replacing oligotropic lakes in certain areas. In addition, we wonder why the author doesn't try to reconcile his speculation that peatland ecosystems "may be easily unbalanced by acid precipitation" with Hemond's (1980) results that peatland dominated by *sphagnum* "totally buffer(s) the effect of acid deposition upon interstitial waters . . . ."

Discussion of options for amelioration of effects is inadequate

Regarding the discussion of amelioration on pages 181 and 182, we would like to make several points. First, we seriously question whether the author has substantiated that degradation of freshwater ecosystems occurs at all precipitation pH levels less than 4.6. Second, raising pH from 4.1 to 4.6 is a 68% reduction and from 4.2 to 4.6 is a 60% reduction in hydrogen ion concentration, not 50%. Third, why does the author single out power plants for control? Assuming that precipitation acidity is proportional to emissions (which most probably is not true) for simplicity, a 60% reduction in total SO_2 emissions would require greater than 100% control of SO_2 emissions from power plants since they contribute about 65% of the U.S. SO_2 emissions. Clearly, this is not physically possible. Some economically feasible compromise would have to be struck. Fourth, we are surprised at the ease with which the author rejects liming as a viable option to "reduce the rate of deterioration of sensitive freshwater ecosystems." To treat surface waters which have been *actually*[1] stressed by acid inputs with lime would cost one to three orders of magnitude less than the emission controls the author advocates. Certainly the most efficacious approach will be a carefully designed combination of emission controls and lake treatments.

Summary conclusions are unsupported by the information given

We find that the author's summary statements on page 182 are largely unsupported by the contents of Chapter 8 or show definite bias on his part. How can the author reconcile his claim that "acid deposition, due to the further oxidation of sulfur and nitrogen oxides released to the atmosphere by anthropogenic sources, is causing widespread damage to aquatic ecosystems . . ." with his statement on page 142 that "direct cause and effect linkages between sources of acid and effects on ecosystems will not be possible in the foreseeable future?"

His summary of terrestrial ecosystem effects is speculative and unbalanced. He points out that there is some evidence of damage to crops but does not state that the damage has been observed in laboratory or greenhouse studies using simulated rain at pH 2 to 4, or that field studies using simulated rain having a pH near that which actually occurs shows no effect or increased yields. He has presented absolutely no evidence that the stimulation of tree growth by acid precipitation will be short lived, yet claims that the effect is expected to be short lived. He completely ignores the fact that acid precipitation contains other nutrients, such as cations, but focuses only on the leaching process. His statement that the control of emissions is necessary to halt acidification is an expression of his opinion, unsupported by the contents of the chapter, and does not demonstrate a rational consideration of the actual mix of ameliorative measures which will ultimately be chosen due to their cost and efficacy.

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[1] Recall that lake acidification has been demonstrated in only relatively small areas of North America.

PREPARED STATEMENT OF AL COURTNEY

Committee Members, Ladies and Gentlemen: My name is Al Courtney. I am Director of Air Quality for Commonwealth Edison Company and Co-Chairman of the Acid Deposition Committee of the Utility Air Regulatory Group. I am speaking today on behalf of the Edison Electric Institute—the trade association of the electric utilities. EEI's member companies generate most of the electricity used in the United States. I would like to thank the members of the Health and Environmental Subcommittee for giving me the opportunity to testify today.

I. INTRODUCTION

During the last few years, "acid rain" has received extraordinary media coverage both in the United States and Canada. Much of this coverage has reflected the view that we face imminent environmental peril if massive control action is not instituted immediately. In reality, however, a careful examination of the available facts leads to four conclusions: first, the only adverse effect which has been documented is the acidification of certain local water bodies; second, the causes of this acidification are not clear; third, the contribution of power plant emissions to this problem is not known, and as a result, it is not known whether emission reductions would retard or reverse this acidification; and, further, requiring substantial additional emission reductions by the electric utility industry would impose great economic burdens on the financially troubled nation and on the already weak economy without assurance of commensurate benefits to the public. Finally, the electric utility industry has been concerned about this issue for some time and has taken the initiative to establish the scientific facts through the research programs of the Electric Power Research Institute and the monitoring effort now conducted as the Utility Acid Precipitation Study Program.

II. WHAT WE KNOW AND DON'T KNOW CONCERNING THE ECOLOGICAL IMPACTS OF ACID PRECIPITATION

In formulating any policy, we should begin by identifying whether there is a problem; and continue by defining the nature and scope of the problem. This logical approach is not being followed in the "acid rain" debate. Proponents of additional regulation related to acid rain have attempted to focus the discussion on a comparison of the costs of alternative control strategies without determining the nature and scope of the problem. This approach avoids rational analysis by *assuming* that the reduction of airborne emissions will produce beneficial environmental results by reducing acid rain.

As the Government Accounting Office has recently noted, many allegations of serious ecological impacts either "do not reflect the current state of knowledge or exaggerate available evidence".[1]

Before turning to the subject of possible welfare-related impacts associated with acid deposition, it is important to recognize that *no* evidence of any harm to human health has been identified.[2] Proponents of controls related to acid rain have speculated that environmental acidification could *theoretically* be of concern to human health, but scientists who have investigated the phenomenon agree that no such impacts have been observed.[3] Nor is there any certainty concerning other allegations of environmental harm. For example, allegations of significant harm to crops from acid rain are based upon laboratory studies[4] that expose plants to a steady diet of simulated rainfall *far* more acidic than may reasonably be expected to occur in nature. Yet despite the unrealistic conditions often used in conducting such research, the results have been enlightening and demonstrate that acid precipitation does not always result in adverse effects on crop growth. In recent analyses performed by EPA, simulated acid rain *increased* the yields of a variety of agricultural crops and reduced damage attributable to insect predators.[5] Research involving impacts on forest productivity further suggests that claims of harm in this area are of questionable validity. In an often cited study, Swedish researchers exposed trees to simulated acid precipitation, and after analyzing prior forest growth, concluded that yields had decreased 2–7% from 1950 to 1965 as a result of precipitation acidity. Subsequent attempts to confirm these results through experiments conducted in Norway and North America failed; in fact, the Norwegian study indicated that pine sapling growth rates *increased* after exposure to acid rain. The point here is not to claim that acid rain is beneficial in all cases but rather to note that it is beneficial in somes cases and that some claims of harm are based on carefully selected evidence. When all of the available information is examined, we discover that the cause and effect relationships are much less certain than some would have us think.[6]

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[1] "The Debate Over Acid Precipitation:—Opposing Views—Status of Research," Government Accounting Office (Sept. 11, 1981), at 3. (GAO Report).

[2] Id. at 5.

[3] The Interagency Task Force on Acid Precipitation, *National Acid Precipitation Plan, supra* note 3 at 40.

[4] GAO Report at Appendix I, p. 9.

In a similar vein, the harm allegedly inflicted upon soil ecosystems has not been documented. Unsubstantiated claims often overlook the fact that soils are generally quite resilient and are able to successfully assimilate a wide variety of chemical inputs, including acid deposition.[7] Furthermore, in areas cultivated for commercial crop production, the impact of acid deposition is generally inconsequential, since the addition of agricultural fertilizers results in far greater impacts. In fact, in some areas in which the concentration of sulfur dioxide in the air has been reduced, increased utilization of fertilizers has been required to offset the loss of sulfur, an element essential for plant growth.

Finally, while it appears that certain naturally sensitive lakes are undergoing acidification, and that increased acidity levels may adversely affect fish, the causes of lake acidification are by no means clear.

Lake water acidity is significantly influenced by the buffering capacity of the lake and the nature of surrounding soil and bedrock. The decay of organic materials in the surrounding watershed may also play an important role in determining lake acidity. There are also potential impacts of shifts in land use practices (*e.g.*, the conversion of pastures to forests and heathland) that increases soil humus content. At least one Scandanavian researcher concluded that such shifts in Norway may be far more responsible for lake acidification than the occurrence of acid precipitation.[8] Further, there are a host of additional factors that may influence lake acidity, including lake stratification, seasonal overturn, aquatic vegetation and temperature.[9]

III. WHAT WE KNOW CONCERNING THE CAUSES OF ACID PRECIPITATION

The question of precise causes of acid rain remains unanswered. At present, we cannot determine the extent to which airborne emissions are contributing to the acidification of precipitation; nor can we determine what effect emission reductions would have on current levels of acidity. Yet this is a crucial question. Without the answer to it, or at least a great deal more understanding than we currently have, we cannot with any confidence develop programs to reduce or control acid rain.

Proponents of additional regulation related to acid rain claim that acid rain occurs as a result of the oxidation of airborne sulfur and nitrogen oxide emissions.

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[5] Lee, *Sulfuric Acid Rain Effects on Crop Yield and Foliar Injury* 8–11 (U.S. EPA Rep. No. 60013–80–016 1980).

[6] United States Department of Energy, *Acid Rain Information Book* 4–16 (May 1981) (Draft Final Report). Several additional studies have indicated that increased sulfur and nitrogen deposition resulting from acid precipitation may enhance forest productivity. See Wood and Borman, *Short Term Effects of a Simulated Acid Rain Upon the Growth and Nutrient Relations of Pinus Strobus*, 7 Water, Air, Soil Pollution 479 (1977)); A28 Abramson and Dollard, *Effects of Acid Deposition on Forest Vegetation* in *Ecological Effects of Acid Precipitation*. Report of a workshop held in Galloway, U.K. (September 4–7, 1078) (EPRI Rep. No. SOA77–403 1979) (Hereinafter cited as Galloway Report).

[7] McFee, *Sensitivity of Soil Regions to Acid Precipitation* 11 (EPA Report No. 600/3–80–013 1980).

[8] Rosenqvist, *Alternative Sources for Acidification of River Water in Norway*, 10, in The Science of the Total Environment 39 (1978).

[9] Holden, *Surface Waters and Aquatic Ecology in Ecological Effects of Acid Precipitation*, in Galloway Report, supra note 12.

Although sulfuric and nitric acid are the major acids identified in rainfall, there is no basis at present for determining the relationship of emissions of sulfur and nitrogen oxides and the acidity of precipitation.

What is clear, however, is that the chemistry involved in the formation of acid rain is complex and is not understood. Uncertainty regarding chemical transformation, for example, prevents scientists from establishing exactly how sulfates and nitrates are derived, where they originate, and how they could be controlled. In a recent discussion of the subject, *Chemical Engineering* reported on the investigation of these issues by Leonard Newman—Chief of the Environmental Chemistry Division of Brookhaven National Laboratory's Department of Energy and Environment—and concluded that:

> there may be a limit to how much sulfur dioxide can be converted into sulfates—a limit fixed by the catalytic materials in the cloud water, such as iron and vanadium. All this suggests that *reducing sulfur and nitrogen emissions could turn out to be irrelevant* if the controlling factors [in influencing acid rain] were something else.[10]

The same point was made by the Government Accounting Office in its recent report.[11] Regional sulfate studies conducted by the Electric Power Research Institute (EPRI) lend support to the hypothesis that sulfate formation may be limited by factors other than the amount of sulfur dioxide present in the atmosphere. Data from recent studies, for example, demonstrate that sulfate concentrations frequently vary more with temperature, humidity and air mass movements than with sulfur dioxide emissions.[12]

The second element of the acid rain equation—long range transport—is also the subject of considerable controversy. Proponents of increased emission controls routinely attribute acid precipitation in the East to emissions from industrial sources—principally powerplants—located in the Midwest. Yet the central postulate underlying this assumption—that significant percentages of utility emissions are typically transported over vast distances—has not been established with any degree of scientific rigor. The uncertainty surrounding long range transport claims recently led the federal Interagency Task Force on Acid Precipitation to conclude that it is "not possible" to determine with confidence the extent to which any specific source *or collection of sources* in one region leads to acid deposition in another region.[13] A report recently prepared for DOE suggests that the long range transport of emissions from coal-fired powerplants may not play as significant a role in determining downwind sulfate levels as has been alleged. The study indicates that sulfate levels may be significantly influenced by *local* sources.[14]

Claims involving the formation of acid precipitation cannot be adequately evaluated until a third piece of the puzzle—cloud chemistry—is better understood. The role of cloud chemistry is quite significant, since the incorporation of atmospheric pollutants in precipitation may be influenced by a variety of factors unrelated to ambient levels of apparent precursors. Dr. Ralph Perhac of EPRI has aptly explained the danger of ignoring chemical processes within clouds:

> What if, for example, under some particular atmospheric condition only 20% of the sulfur in the air could get into rain drops? Under that situation we could remove most of the sulfur and still have no effect on the acidity of the water . . . [U]ntil we know how acid rain actually forms . . . we will not know what effect increasing or decreasing powerplant emissions will have.[15]

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[10] Shaw, *Debate Over Acid Rain Will Intensify in 1981,* Chemical Engineering, Feb. 9, 1981, at 46 (emphasis added).

[11] GAO Report, at Appendix II, p. 23.

[12] Testimony of Dr. Ralph Perhac before the Subcommittee on Environmental Pollution, Senate Committee on Environment and Public Works (Mar. 19, 1980), at 10–11.

[13] *National Acid Precipitation Assessment Plan* at 35. (emphasis added). The Task Force's conclusions regarding the uncertainty surrounding long range transport reflect concerns raised by witnesses who have previously testified before House and Senate Committees. *See* Perhac Testimony *supra* note 5 at 10–11; Hearings on Acid Rain Before the Subcomm. on Oversight and Investigations of the House Comm. on Interstate and Foreign Commerce, 96th Cong., 2d Sess. 65–66 (February 27, 1980) (Testimony of former EPA Administrator Douglas Costle).

[14] United States Dep't of Energy—Office of Fossil Fuel, *Acid Rain: The Impact of Local Sources*, 8, 11 (November 24, 1980).

[15] Perhac Testimony at 12. Alkaline dust particles in the atmosphere may also play a significant role in determining precipitation acidity, since the presence of significant ambient concentrations may partially neutralize acidic input prior to deposition. See Stensland, *Precipitation Chemistry Trends in the Northeastern United States,* in *Polluted Rain* 87 (T. Toribasa, et al eds. 1980).

IV. IS THERE A TREND TOWARD INCREASING PRECIPITATION ACIDITY?

Demands for immediate emissions reductions are frequently based on allegations that precipitation acidity has worsened considerably in recent years and will presumably continue to intensify if immediate controls are not adopted. In reality, however, such depictions of recent events and predictions of future trends conflict with the results of highly significant studies recently undertaken by Environmental Research and Technology (ERT) and EPRI. The ERT study, for example, involved an exhaustive evaluation of the precipitation monitoring data including that data upon which proponents of control have relied. After analyzing in detail the results of monitoring programs conducted throughout the East, the authors determined that the data collected do *not* justify the conclusion that precipitation acidity in the East has increased in intensity over the last 50 years.[16] Similarly, although there have been claims that the Canadian precipitation monitoring system shows that acid rain is increasing in intensity in that country, the Atmospheric Environment Service has recently recognized that these data are unreliable and that such conclusions are not well-founded.[17]

In an effort to obtain reliable monitoring data and evaluate claims regarding precipitation acidity trends, Electric Power Research Institute instituted a nine-station monitoring network in September, 1978. The network is currently being expended and operated under the Utility Acid Precipitation Study Program, which is sponsored by a concerned group of electric utility companies. The program is designed to avoid many of the problems of the past, such as inconsistent siting of monitors, reliance on data not converted to weighted averages—lack of documentation, and lack of quality control. The UAPSP will be coordinated with other precipitation chemistry networks in order to evaluate data comparability and determine equivalent methodologies for the purposes of multi-network data analyses. The end result should be an improved and expanded data base for determining actual acid precipitation as a function of time and place. Limited results to date are quite interesting: monitoring conducted during 1979 and 1980 revealed *less precipitation acidity at every* station in the nine-site network in 1980 when compared to values recorded in 1979.[18] Obviously, since these results are for only a two year period they are not conclusive.

In light of the results of these studies, claims that precipitation acidity is accelerating at an alarming rate must be viewed with considerable scepticism. They also indicate that dispassionate analysis strongly counsels against the immediate imposition of enormously expensive additional emission controls and in favor of a rational investigation of the phenomenon before decisions concerning the need for countermeasures are made.

V. THERE ARE INTERIM MITIGATIVE ACTIONS THAT CAN BE TAKEN

Because of the uncertainty surrounding the cause and effects of acid precipitation no one knows whether or how much precipitation acidity would change even if substantial emission reduction requirements were imposed. We simply do not know at this point *what effect* emissions reductions, particularly at distant sources, would have on precipitation acidity.

Because the relationship between emissions and ecological impacts associated with aquatic acidification is so uncertain, it would be far more effective if specific ecological concerns were identified and measures were instituted to remedy the problems directly. As the GAO's recent Report noted, the only clear evidence of harm from acid rain involves the possible acceleration of aquatic acidification in certain naturally sensitive lakes.[19] Since lakes typically acidify as a result of an inability to buffer incoming acidity, the replacement of natural alkaline agents could in theory address this problem (and has done so in the past). Analyses of lake restoration projects that have already been undertaken confirm that the addition of limestone may constitute a potentially effective mechanism for combatting lake acidification. Researchers report that the introduction of lime has led to: (1) increases in pH, (2) increases in the diversity of phytoplankton and zooplankton species, (3) better balances in total fish biomass and (4) decreases in concentrations of potentially toxic heavy metals.[20] While liming is not feasible everywhere, it may be an important interim measure to mitigate the effects of acidification until there is more certain knowledge of its causes. This and other mitigation measures should be pursued vigorously while the necessary research to determine causes of environmental acidification is underway.

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[16] Hansen, Hidy and Stensland, *Examination of the Basis for Trend Interpretation of Historical Rain Chemistry in the Eastern United States* iv (ERT Document No. P–A097R, August 1981).

[17] James Young, Atmospheric Environment Service/Environment Canada, Speaking to Transboundary Work Group 2 (May 11, 1981).

[18] Address by Dr. Ralph Perhac, Conference on Acid Rain, in Arlington, Virginia (Dec. 12, 1980).

[19] GAO Report at 4–5.

VI. THE ECONOMIC RISKS OF PREMATURE REGULATORY PROGRAMS

The uncertainties that pervade the acid rain issue suggest that caution must be exercised prior to establishing any additional regulatory requirements. The expenses associated with a "significant" emission reduction will be very great. Such costs simply *cannot* be justified at the present time in light of the highly speculative nature of the benefits that *might* result from additional controls. Although actual control costs are likely to be much higher, the potential magnitude of the costs is illustrated by the following:

> In an analysis of control measures prepared for the National Commission on Air Quality, the Environmental Law Institute estimated that the retrofitting of SO_2 and NO_x controls at a small group of relatively high emitting facilities would result in capital costs of $7–14 billion, and additional annual operating costs of $1–2 billion.[21]
>
> Recent estimates prepared in conjunction with DOE acid rain studies indicated that the capital costs of scrubber retrofitting (designed only to reduce SO_2) at the 50 largest sulfur dioxide emitters east of the Mississippi would approach $12.5 billion.[22]

Under any circumstances such expenditures would be burdensome; however, in light of the financial ills currently plaguing the nation the additional costs could prove to be very debilitating.

While it is true that the electric utility industry can pass on these costs to its customers, there is a clear obligation to ensure, to the extent practicable, that commensurate benefits will result from the imposition of such costs. Yet at the present time there is insufficient basis for concluding that any benefits will result from additional emissions controls.

VII. WHAT SHOULD BE DONE NOW

It is clear that many of the critical chemical, meteorological, ecological, and economic questions related to acid rain remain unanswered. But we do not want to use unanswered questions simply as an excuse for delay. We therefore recommend that the Energy Security Act's[23] ten year acid rain research program be accelerated substantially. Specifically, EEI favors an intensification of research efforts aimed at producing results within *five years*. We wish to emphasize that, in order to produce meaningful results in this time frame, it will be necessary to concentrate on carefully defined objectives. This will require a well-planned, coordinated effort by government and industry. As previously noted, the electric utility industry has already taken relevant initiatives through the Electric Power Research Institute and the Utility Acid Precipitation Study Program. In addition, individual utility companies have been working cooperatively on related programs with agencies of local and state governments.

An aggressive effort to improve the coordination of the existing and planned programs would greatly improve the value and extent of information which can be achieved in an accelerated five-year program. It is also timely to begin the development of criteria for determining when available information will be sufficient for the purpose of making decisions regarding appropriate acid rain control strategies which may be needed. The five year goal could prove particularly appropriate in light of current projections that dramatically less expensive methods of NO_x and SO_2 removal may be commercially viable by the mid to late 1980's if the facts prove that they will be needed. The program could also be structured to require the Administrator of EPA to make a determination at the end of the five year study as to whether emission reductions or other control measures are necessary.

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[20] *DOE Acid Rain Information Book*, supra note 6 at 5–1, 5–2. A recent analysis of European lake acidification confirms that liming may represent a far most cost-effective alternative than installing sulfur dioxide emission controls. See Barnes, *Acid Rain—An International Concern*, 30 J. Air Poll. Contr. Ass'n (1980).

[21] Environmental Law Institute. G. Wetstone, P.D. Reed, "Draft Final Report Institutional Aspects of Transported Pollutions—An Examination of Transport Reduction Strategies", 19, 148 (prepared by the Environmental Law Institute for the National Commission on Air Quality, January 12, 1981).

[22] *DOE Report on Local Sources*, at 28.

[23] 42 U.S.C.A. § 8901 et seq. (Supp. III 1980) (Appendix I).

We also believe that pending the completion of the research program established by the Acid Precipitation Act of 1980, claims regarding irreversible ecological impact should be investigated and mitigating measures, such as liming, should be instituted where appropriate. The adoption of a mitigation-oriented approach in the interim would produce significant benefits: first, ameliorative action could proceed irrespective of the controversy regarding the origins of a particular acidification problem; second, the underlying ecological problem—such as lake acidification—could be addressed *directly*, which would allow time for sound, long-term solutions to be implemented. Common sense, the uncertain state of current scientific knowledge, and economic considerations *all* militate in favor of avoiding expensive emission control requirements that might ultimately prove to have been ineffective or unnecessary.

CONCLUSION

In conclusion, I ask that the Subcommittee carefully consider the critical, unresolved issues surrounding the acid rain phenomenon. In enacting the Acid Precipitation Act of 1980, Congress recognized this essential prerequisite and in response, instituted a program designed to explore the acid deposition phenomenon in a deliberate, methodical manner.[24] We should permit this rational, problem-solving approach to produce the information which we so badly need. The electric utility industry is willing to actively participate in all aspects of acid rain research which pertain to our operations, and we pledge full cooperation with the government in analyzing the facts and developing cost-effective countermeasures where they are needed to protect the public interest.

J. THEODORE MEYER,
STATE REPRESENTATIVE, 28TH DISTRICT,
Chicago, Ill., March 18, 1982.

Senator LARRY PRESSLER,
Chairman, Subcommittee on Arms Control, Oceans, International Operations, and Environment, Committee on Foreign Relations, Washington, D.C.

DEAR SENATOR PRESSLER: During the question and answer period following my testimony on "acid rain" on February 10, 1982, you asked for my comments on whether Canadian interest in the topic was principally motivated by a national energy strategy, rather than a sincere interest in the ecology of their sensitive areas. I would like to expand upon my response to your question, and I appreciate the opportunity which you extended then. I have also taken the opportunity to expand on the question of shifting costs, a proposal put forth by Senator Mitchell to characterize his legislative proposal simply as a shift of unrealized costs, and not as a new regulatory burden.

AN ENERGY CONSPIRACY?

As I stated, Canadian interests are not principally motivated by an energy strategy, as far as I know. However, energy generation and "acid rain" are inextricably linked. For example, it is the plain fact that Canadian sulfur demands focus on power generation in the U.S. while they are significantly less interested in the NO_x emissions from mobile sources. It is also the plain fact that energy development interests in Canada will be served by additional regulation constraining U.S. generating capacity. Canadian electricity exports clearly allow Provincial Government corporations to maintain power demand at levels sufficient to justify past and future capital uses, and to subsidize consumer rates.

Canadian-U.S. power relationships are growing as U.S. interest in Canadian power is increasing. This increase in demand may explain why Ontario Hydro, the Provincial Government power entity, has *accelerated* construction of new power facilities (CANDU reactor units) on a system that is already well over 20 percent in excess of demand, and while they also have access to huge surpluses from the Quebec Hydro system.

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[24] 42 U.S.C.A. § 8901 et seq. (Supp. III 1980) (Appendix I).

It is difficult to see the economic reality behind the Canadian surplus position when Ontario and Quebec are considered together. Both systems have had large surplus supplies of energy while construction programs for new capacity (Quebec's James Bay hydroelectric project came on-line within the last three months). From looking at supplies and demand, it remains to be seen why the massive capitalization for CANDU construction in Ontario was necessary, especially since Quebec now sells power to Ontario at 80 percent of the cost of Ontario generation by unscrubbed, coal-fired facilities (note that Ontario operates at least one such coal fired facility wholely for export purposes). Obviously, export revenues from existing generating capacity help to cushion the Canadian investment programs from economic realities and from public concern about tax or deficit spending support for such efforts. Canadian-U.S. power relationships are also growing in some degree because of the need for this cushion.

Growth in Ontario exports from increased coal use seems to fly in the face of the politicians' "acid rain" demands. I believe there are at least a few good political reasons for this. For instance, Premier Renee Levesque of Quebec has publically stated that he will continue to support hydroelectric projects in Quebec because it creates jobs for Quebecois. For Ontario, CANDU construction creates domestic jobs and supplies a protective base of activity for their domestic nuclear industry, an industry that is facing extinction with little prospect for new orders. These two Governments are taking political steps to serve their Provincial interests by placing investment realities and environmental concerns aside.

The Canadian National Government is not ignorant of these Provincial interests. In fact, in the energy development area Canada has an overall National Energy Plan (NEP), it has established a National Energy Board (NEB), and it is well recognized that their energy policy considerations are much more focused than in the United States. In licensing exports which contribute to Canadian and Amercian pollution problems, the National Government has clearly endorsed Provincial interests.

Energy, environmental and economic linkages and dependencies exist. Whether this is evidence by itself that a "conspiracy" exists, is doubtful. Still, a respected environmental group in Canada, Energy Probe, has supplied my staff with a draft document reported to be the final concluding chapter of a Canadian National Government study answering the question of whether their CANDU industry is worth maintaining, and how to go about maintaining it.

The study was at least a year in preparation, background papers being published in early 1981, and it was conducted by three Ottawa agencies including the Ministry of the Environment. Portions of this document are disturbing, and I would suggest that the Committee seek to verify its validity, and discover whether Canadian Governments are acting along the lines outlined within it. I have enclosed a copy here.

Let me highlight a brief portion dealing with the power export "window" available to the Canadlan government corporations. The report states that an export market exists through (1) the displacement of U.S. oil-fired facilities, (2) the filling of gaps in U.S. capacities stemming from U.S. regulatory delays, and (3) "the possibility of pre-empting the construction of coal fired generation in the United States . . . because of the increasing real price of coal and the high costs of environmental measures", page 98, (emphasis added).

In the United States burning high sulfur coal in new facilities would bring about the strictest of environmental controls under the present Clean Air Act. Even with these strictest of environmental measures, all Illinois utilities state that a decided cost advantage, not a disadvantage, now exists for use of high sulfur coal over nuclear units and low sulfur coal "imported" from western states (I do not know how the costs of this environmentally sound use of high sulfur coal compares with CANDU generation, or with Quebec hydroelectric power which might be "wheeled through" at some modest increment above Ontario's purchase cost of 80 percent of generation from their own coal fired facilities). However, pre-emption possibilities do exist if Canadian costs are really competitive, or if New U.S. *environmental measures* reduce cost options for U.S. utilities, or for both reasons. Under Canadian "acid rain" demands the possibility for pre-emption by export becomes that much more certain with the loss of the high sulfur fuel option, especially in light of the huge costs of new capital, the uncertainties of future electricity requirements, and the risks of new construction programs facing our American industry.

Of course, Canadian competitive abilities are substantial even without the creation of additional new regulation of domestic power generation. Their power industry is not an industry at all. Provincial corporations are government entities having the ability to raise "cheaper" capital backed by the full faith and credit of Governments, they have access to government mandated pension system funds at protective rates, and they have access to Ottawa Government subsidies for the construction of nuclear facilities. A close review might now surface anti-competitive charges against these government corporations. Indeed, if a policy of pre-empting American industrial development is being pursued, I believe we should be concerned.

To summarize, Canadian governments now authorize electricity production for export in support of political and economic interests. This electricity production results in unnecessary increases in pollution. While this increase in pollution is certainly a concern to the Canadians, it is clearly secondary to the production and export of electricity. In addition these plain tracing models and the knowledge of chemical activities in the air system is inadequate at this time. The question still remains in my mind, then, whether Canadian political and economic interests might again dominate and possibly use a very sincere environmental concern to the advantage of these interests.

LEGISLATION REALLOCATES COSTS?

Senator Mitchell characterizes his legislative proposal as shifting costs borne by our natural resources on to those who presumably are causing these "costs" to be incurred. I'll not argue against this presumption, as I am hopeful that our scientists can solve the practical problems not yet resolved so it becomes possible to mitigate ecological stress in a reasonable way, and distribute the "costs" appropriately.

Yet the "acid rain" proposals, if enacted, will undoubtedly create real costs to be borne for decades by consumers, miners, people and families. The question before Congress in these measures, it seems to me, is the old cost-benefit question of how to value people's lives compared with government interests. As an elected representative of fourteen years I know that even with all the facts before us, these choices are never easy to make. As an elected representative of a small portion of the families who would be affected by such government action, I'd say that there is no point of comparison here, and plead with you that the Congress cannot make such a choice on the facts before us.

Thank you very much for the opportunity to appear before your Subcommittee. I hope that my remarks and comments will be helpful to you and your Colleagues. In particular, I would be happy to spend some time with you or your staff to expand on the alternative action I proposed in my statement.

Very truly yours,

J. THEODORE MEYER.
Chairman, Energy and Environment Committee.

Enclosure.

ENERGY PROBE/ENQUÊTE ENERGÉTIQUE,
Ottawa, Canada, October 26, 1981.

JIM FRECH,
Illinois General Assembly, Washington, D.C.

DEAR JIM: I am enclosing the concluding chapter from the draft version *Nuclear Policy Review* which we received in June 1981. The final version of that report has not been published yet. The background papers have though and they are called *Nuclear Policy Review—Background Papers,* Catalogue Number ER 81-2E and were published by the Special Studies Division, Dept. of Energy, Mines and Resources. Particularly noteworthy in that book are Tables 6 and 7 in Paper No. 1, which show how our provincial utilities (the government-owned producers of electricity) have consistently overestimated demand for electricity relative to EMR's forecasts (which are probably themselves on the high side).

Have you heard of the Canadian Coalition on Acid Rain? It's a coalition of Canadian environmental groups with an office in Washington, set up to lobby Congress. The contact there is Adele Hurley and their address is 1825 K St. NW, Suite 206, Washington, D.C.

The address for the Dept. of Energy, Mines and Resources is 580 Booth Street, Ottawa, K1A OE4.

Cordially,

MARGARET OLDFIELD.

6. POLICY OPTIONS: OVERVIEW

The previous sections have attempted to establish the central thesis of the paper:

Given reasonable assumptions about rates of growth of GNP, changes in energy prices, and other important factors (population growth, for example), consumption of electricity will continue to grow for the rest of the century at rates which will likely remain well below recent historical averages.

Many utilities (eg. Ontario Hydro) currently have some excess capacity. However, a comparison of demand forecasts with existing and committed capacity indicates that significant additions to capacity will be required to meet load growth in all parts of Canada in the 1990's.

Options for meeting projected load growth will be limited to coal, hydro and nuclear. Given the increasing costs of coal and hydro—in both economic and environmental terms—CANDU reactors are an attractive option for meeting load growth, particularly east of Manitoba. There is, therefore, a good economic argument for maintaining the nuclear option to the 1990's.

The situation over the next few years, however, may threaten the maintenance of the option. Given excess capacity being experienced by key utilities (e.g. Ontario), and reduced forecast rates of electrical demand growth in most of the provinces which have a nuclear program, domestic orders in the 1980's will be limited. The gap left by the absence of domestic orders might be filled by export sales, but competition in the export market is fierce. Mexico, Korea and Romania are the best near term prospects, but are by no means assured. Other prospects are concentrated late in the decade, too late to provide immediate relief to the industry, and are in any case highly uncertain. Overall, the 1980's will be a very difficult decade for the reactor supply and heavy water industries.

The commercial outlook for the 1980's may cause severe disruption within the Canadian nuclear industry. If actual sales performance coincides with one of the more cautious scenarios, all firms surveyed, and by implication virtually all firms in the industry, will be without nuclear business by 1985-86.

Even the most optimistic scenario indicates that the current structure of the industry cannot be maintained in the 1990's. Only one supplier of each component will remain in the nuclear business.

The rest of the paper sets out specific policy options which could be pursued in response to the situation outlined above. Section 7 discusses options for the domestic reactor market; Section 8, the possibility of dedicated exports of electricity to U.S. markets; Section 9, options for the reactor export market and Section 10 the option of taking a laissez-faire approach.

7. POLICY OPTIONS FOR THE DOMESTIC MARKET

7.1 INTRODUCTION

The underlying determinant of the size of the domestic market for nuclear reactor is the rate of growth of electricity demand. One general option, therefore, is to promote the rate of growth of electricity demand over and above market determined levels. Not only would this increase capacity utilization in the industry, it would also substitute indigenous Canadian resources for costly and insecure imported energy.

There are drawbacks to pursuing such a policy. First, the scope for increasing electricity demand growth over market determined levels is limited by technical and economic factors. Forecasts show that the influence of market factors alone will cause the rate of growth of electricity to exceed growth rates of other types of energy for the rest of the century: thus, electricity substitution is largely internalized in the demand forecasts. Substitutions beyond these levels are of course possible but are limited by end use technologies—the difficulty of using electrical energy in transportation for example. Second, acceleration of electricity growth on a nationwide basis would be a rather blunt instrument to increase the demand for reactors in Ontario, Quebec and the Maritimes. However, accelerated electricity substitution is a legitimate objective of provincial policy (e.g., in Ontario and Quebec) but is not reflected in this analysis.

There are, however, a number of factors which more directly determine the demand for reactors and which the government can influence in a positive way. These options are the subject of this Section of the paper.

7.2 OPTIONS TO IMPROVE PUBLIC ACCEPTABILITY

Problems of public acceptability have made utilities increasingly reluctant to pursue the nuclear option. Major public concerns include the long term management of radioactive wastes, the safety of reactor operation, and the possible impacts of nuclear energy on human health and the natural environment. While a general statement of the government's continuing support for the development of nuclear energy might be useful to a certain extent, and would be enthusiastically welcomed by the industry, it is clear that much more than a public relations approach is required.

A good example of possible positive action is in the area of radioactive waste management, which public opinion polls indicate is an important factor in public opposition to further nuclear expansion. It is also one of the areas in which public perceptions differ most sharply from the views of scientists and engineers to whom the waste disposal problem appears more easily amenable to solution than a large number of non-nuclear related environmental and safety problems.

The federal and Ontario governments, through AECL and Ontario Hydro, have an active program in spent fuel disposal. While still in an early stage, a considerable amount of information has been accumulated in the process of concept verification. One straightforward option, therefore, is to issue a clear indication of confidence by the government that the waste management question is on its way to solution, and at the same time providing increased funding of the waste disposal program to allow it to proceed at the technologically determined pace.

7.3 IMPROVED NUCLEAR INCENTIVES TO THE PROVINCES

As pointed out above for most non-nuclear provinces the existence of more economical generation alternatives makes entry into a nuclear program unlikely for the next two decades. With respect to provinces which have a nuclear program, Ontario suffers from over capacity and a sluggish outlook for electrical demand growth. Therefore, the two provinces in which federal action might have a direct impact are New Brunswick and Quebec. There are a number of outstanding issues between the two levels of government, the resolution of which may promote nuclear development in each province.

The most important of these issues is federal financial assistance. Current federal government policy provides for financing at crown corporation rates for 50% of the estimated cost of the first nuclear unit in each province.

There are two problems with this policy. First, because the federal share is based on estimated as opposed to actual costs, and because most nuclear projects have experienced substantial cost over-runs, the actual federal share has fallen well short of 50%. This has proven to be a contentious issue in Quebec and New Brunswick, with New Brunswick in particular seeking improved support from the federal government.

Secondly, assistance is limited to the first commercial reactor built in each province or to a subsequent reactor participating in a regional grid. This significantly limits the effectiveness of the program. First, it is unlikely that any province without a nuclear program at present will be induced by such an incentive package to make a commitment to a reactor. Second, in those areas where financial assistance might induce additional commitments—New Brunswick (LePreau 2) and Quebec (G–3)—the reactors are excluded because they are the second units in a program, and are not covered by regional power-sharing agreements as required by federal policy.

Other program issues require resolution. Quebec, for example, is seeking compensation for cancellation by the federal government of the LaPrade heavy water plant.

An effective policy could involve a comprehensive solution of all outstanding issues between both provinces and the federal government in return for firm commitments to LePreau 2 and to G–3. Such a policy could involve:

Extension of financing to 75% of the delivered cost of a reactor unit;

Extension of favourable financial treatment to the 2nd reactor unit in each province;

More favourable interest rates and repayment terms; consideration of federal equity participation in reactor projects;

Sale or transfer of G–1 reactor to Quebec; and

Settlement of outstanding claims for compensation for LaPrade.

This package would invlove federal expenditures, some of which have already been agreed to (e.g. $200 million for LaPreau compensation). The benefit would be increased by domestic sales, and added momentum, for the domestic nuclear program. Solving federal/provincial problems would also demonstrate to foreign customers a clear Canadian commitment to the nuclear option. A further benefit, although hard to quantify, would be the additional incentive to non-nuclear provinces to embark on a nuclear program.

7.4 RATIONALIZATION OF HEAVY WATER PRODUCTION

While the heavy water industry shares many of the problems of the reactor supply industry, its unique technical and economic characteristics make the situation even more critical.

As noted earlier, in the case of heavy water, decreases in demand experienced throughout the industry are aggravated by the desire of potential CANDU customers to build their own heavy water plants. In addition, unlike the reactor supply industry, heavy water producers can produce only heavy water, and heavy water has no alternative markets. Finally, for technical reasons plants must be run close to full capacity or not at all. Thus, it is difficult for heavy water production to adjust to decreases in demand. The stark alternatives are to accumulate costly inventories or to shut plants down. It is not clear, however, that a mothballed plant can ever be returned to production, so that closing a plant for an extended period may involve its total write-off.

There does not appear to be any plausible scenario in which the output of all Canada's heavy water plants will be required. AECL has already begun to accumulate inventories. Even with the most optimistic sales scenario, AECL and Ontario Hydro inventories could total 15 reactor loads by 1990 at a cost of about $2.0 billion (1980). There is, therefore, a strong case for industry rationalization.

Rationalization involves difficult decisions. On the one hand, Ontario Hydro's heavy water plants are both more efficient than AECL's Maritime plants and large enough to supply the domestic and foreign markets by themselves. There is, therefore, a good economic argument for concentrating all heavy water production in Ontario, with an arrangement by which AECL is guaranteed supplies at reasonable prices.

On the other hand, AECL's Maritime plants are an important source of income and employment in an economically depressed region. Closure of the plants would generate adverse socio-economic impacts. Further, closure of AECL's plants might affect Canada's ability to sell reactors abroad. Foreign customers might be reluctant to buy from a company unable to guarantee a supply of heavy water.

In sum, heavy water poses difficult problems. Rationalization is clearly required, but aside from an improvement in economic efficiency, it is difficult to forsee any gains from a rationalization decision in terms of the problems facing the industry as a whole. It is, for example, difficult to argue that a rationalization decision will increase the chances of domestic or foreign sales. At best, it will leave them unchanged. At worst, it could have a significant adverse impact on AECL's ability to market CANDU in export markets.

7.5 CONCLUSIONS

While scope for policy action in the domestic market is limited, some positive steps are possible. The most promising options for improving the industry's prospects in the short run are policies aimed at achieving an early commitment by Quebec and New Brunswick to Gentilly-3 and LePreau 2 respectively.

8. Reactors For Power Exports

8.1 INTRODUCTION

Building reactors for power export is an attractive option for a number of reasons. Potential profits are likely to be significant. In addition, such a program would increase throughout in the domestic nuclear industry at a time of excess capacity, earn substantial amounts of foreign exchange and be consistent with established policies of maximum upgrading of Canadian resources (uranium) before export.

On the other hand, dedicated exports would create incremental risks in terms of public acceptability. Concerns over risks posed to public health and the natural environment would have to be carefully addressed and resolved. In general, for any given site these risks are the same as those posed by the production of nuclear electricity for domestic use. Additional risks posed by a dedicated export are those associated with the number of reactors in operation, and the volume of radioactive waste which must ultimately be disposed of.

Aside from problems of public acceptability, establishing the feasibility and desirability of dedicated exports involves addressing some difficult issues. First, a market must exist for electricity exports in general. Second, CANDU reactors must be capable, in economic terms, of capturing a share of this market. Finally, there are complex institutional, regulatory and contractual hurdles to be overcome.

This section consists primarily of a general discussion of the first two issues: the existence of a market and the degree to which CANDU generated electricity might penetrate this market.

8.2 THE MARKET

Firm export opportunities could arise for three reasons. In the first place, U.S. utilities which still rely on baseload oil-fired generation will have an incentive to import firm power from Canadian CANDU reactors, if imported energy is less expensive than burning oil. This is the oil displacement market. A second type of opportunity arises when because of regulatory delays, U.S. utilities are unable to put capacity in place in time to meet load growth, leaving a gap between available capacity and the utilities' requirements. This is the "capacity constrained" market. A third type of export opportunity, somewhat more speculative, arises from the possibility of pre-empting the construction of coal fired generation in the U.S. Costs of energy from new coal fired capacity are expected to be higher than the cost of energy from CANDU because of the increasing real price of coal and the high costs of environmental protection measures.

Empirical work undertaken by EMR has tentatively identified the potential size of each of these markets over the next twenty years. The results should be considered as suggestive only.

First, making a number of assumptions about the rate at which U.S. utilities will substitute other generation for oil-fired facilities, and the economics of generating and transmitting power from CANDU reactors, over the period 1989 to 2001 a potential "oil-displacement" market for the output of five or six 630 MW reactors in New Brunswick and from five to seven 850 MW reactors in Ontario exists.

Second, an assessment of the overall size of the capacity constrained market was made. While again uncertain, an opportunity appears to exist for a share of a market of between 19,500 and 24,000 megawatts of baseload capacity from 1990 to the turn of the century. Each three to five percent share of this market would represent the capacity of about one CANDU reactor.

The share of each market ultimately captured by exports from nuclear facilities will, of course, depend on the nature and cost of alternatives facing potential importers: for example, imports from other U.S. utilities; hydro power from Quebec; demand reduction by electrical load management. However, as indicated earlier, nuclear energy is an economically attractive technology for baseload generation when compared to alternatives available. Therefore, while a significant fraction of the export market could be captured by low cost hydro, a large and profitable market for exports from nuclear reactors can be projected over the next twenty years and perhaps beyond.

It should be noted that both of the displacement markets may be of limited duration. First, most U.S. utilities have an active policy of substituting out of oil-fired capacity. Once such a program is carried out, an oil displacement market will no longer exist. Export opportunities arising from U.S. capacity shortages may also be short lived. Problems experienced with obtaining approval for additions to capacity will likely be resolved over the long term, as the economic and energy consequences of continued delay become apparent. For this reason, the export of CANDU based electrical energy may be confined to an "export window", beginning in 1990 and lasting to 2000 or 2005. Preliminary analysis indicates that pay back times are short enough to allow attractive profits from even these brief windows if acted upon quickly. Given lead times involved in reactor construction, this implies a decision must be made soon if Canada wishes to take advantage of this market. However, the third type of market for CANDU, displacement of coal fired generation, is a longer term opportunity based on comparative costs of generation alternatives.

8.3 OPTIONS FOR MEETING ELECTRICITY EXPORT DEMANDS

There are two basic options for meeting export demands. The first option involves the construction of dedicated plants which would provide baseload power to U.S. utilities over a period encompassing the life of the facilities. The second involves prebuilding a number of CANDU units to supply American markets in the initial years of operation but with the ultimate intention of repatriating the power to meet expected Canadian demand.

Dedicated electricity sales from a nuclear plant could be undertaken by an existing utility, or through the formation of new corporation. In either case, this option would require extensive market research, the negotiation of contracts, and possibly the selection of a site, and the ultimate design and construction of nuclear export facilities. Given present conditions, the lead time might be from 10 to 15 years. This delay considerably reduces the attractiveness of a dedicated plant for the oil displacement or capacity constrained markets, but would be less of a problem for the coal displacement market.

Prebuilding options would involve advancing the construction schedules of nuclear plants eventually needed to meet expected domestic load growth in Ontario and/or New Brunswick: Darlington or Lepreau II. One advantage of this scheme is that lead times are significantly reduced, thereby taking full advantage of the forecast market window.

The objective of a prebuilding scheme, from a utility's point of view, is to earn profits on sales of energy to the U.S. In the long run, domestic benefits will appear as lower rate structures for domestic consumers. One drawback, however, is that because of the interaction of financial requirements, inflation, construction schedules and export sales, domestic rates may well *increase* in the short run. This reduces the attractiveness of such a scheme to the utility's consumers. However, it may well be possible that all costs can be financed by potential imports under long term purchase agreements.

Firm contracts with U.S. importers are desirable, but not an absolute necessity for a pre-building scheme. The option exists of building expected U.S. demand into the load growth forecasts, and designing a construction schedule accordingly. This would prove attractive if the forecast U.S. import demand turned out to be correct, or if the Canadian situation changed abruptly such that power demand increased more rapidly than expected. The risk, of course, would be that neither of these developments might occur or that transmission limitations would serve to "bottle-in" the surplus Canadian power. Canadian consumers and taxpayers would then bear the costs of the excess capacity. This would be a fairly high risk option in terms of public acceptability.

8.4 CONCLUSIONS

A preliminary economic and market analysis undertaken by EMR indicates that a large profitable market for electricity exports from Canada will develop in the U.S. over the next twenty years. Economic analysis suggests that exports from CANDU reactors would be capable of capturing a portion of this market. Constructing reactors for power export could, therefore, generate attractive economic returns and, in addition, provide badly needed business for the Canadian nuclear industry at a time of over capacity. However, due to the high degree of uncertainty in any longer term forecast of markets and comparative cost, the risks of building generating capacity in Canada to take advantage of this potential export opportunity have to be carefully weighed in relation to the potential benefits that exports provide. These risks could be reduced by long term contracts with importing utilities. Because the market window is expected to start around 1990 and last only until soon after the turn of the century, and because of the long lead times for nuclear plant commissioning, delays in deciding whether to pursue this option will render the oil displacement and capacity constrained markets increasingly risky bases for promoting an export program.

Important non-economic risks are also involved, including increased environmental and safety risks and the commitment of Canadian non-renewable resources to long-term export contracts. Before any construction for export could take place, American utilities and regulatory agencies would have to indicate, through contractual commitments and clear authorization for imports, their willingness to allow some utilities to become dependent on a Canadian supplier for a vital energy form. Further, transmission capacity is a factor of prime importance in any firm export proposal. The construction of increased transmission facilities on both sides of the border is a prerequisite to increased electricity exchanges between Canada and the United States. Because of strong environmental opposition to transmission lines, this could be a serious bottleneck.

Aside from long lead times, other important barriers to a dedicated export scheme are non-economic and non-technical. They are problems of overcoming institutional barriers, securing regulatory approvals, and, above all, achieving public acceptability. The key question to be answered at this stage, then, is whether further investigation of this potentially lucrative market is warranted; or whether overall public acceptability is so unlikely as to make further efforts futile.

9. POLICY OPTIONS FOR EXPORT MARKETS

9.1 INTRODUCTION

Section 4 discussed the key factors influencing export performance. The results are summarized in table 16. While table 16 does not attempt to list the factors which influence export sales in order of importance, it is worth noting that the apparent technical superiority of CANDU appears to play a less significant role in a successful sales effort than conventional Canadian wisdom would indicate. In fact, Canada's emphasis in the past on technology has led to a perception of AECL as a research and product oriented company, lacking in commercial and project management skills.

More positively, there are a range of non-technological factors which could be altered to enhance Canada's foreign sales prospects. Some constraints imposed by the federal government on the nuclear industry (safeguards, political exclusions) can be modified as appropriate by the government. Others, such as technology transfer, fragmentation of the Canadian industry and the credibility of Canada as a supplier can only be changed by the actions of the industry itself. Still others (marketing, finance, countertrade) may involve co-ordinated action by the government, AECL and private industry.

There is a broad continuum of policy options ranging from relatively straightforward changes in administrative procedures, to much more fundamental changes in financing or safeguard policies. Costs, risks and benefits are in some cases high and difficult to define and quantify.

TABLE 16.—*Factors affecting export sales performance*

Factors	*Perceived Canadian performance* [1]
1. Credibility of the supplier record in constructing other reactors; number of similar reactors in service; several suppliers of the same type of equipment; ability to transfer technology)	Weak.
2. Inter-Governmental relations (machinery of government; political exclusions; safeguards; financing terms; development of favourable trading arrangements; guarantee of fuel supply/waste storage and/or processing	Weak.
3. Marketing strategy (marketing strategy, and personnel; identify and contact all significant decision makers; provision of technical information; commercial and contractual know-how)	Weak.
4. Technical (cost; performance; safety; unit size; fuel cycle; future development)	Strong.

[1] Subjective perceptions of Canadian performance based on field interviews.

First, export of "big ticket" items such as reactors is inherently risky—financial losses can never be ruled out. Second, the international market is highly competitive and sales prospects very uncertain. This means, for example, that devoting more resources to international marketing or altering safeguard policies will not assure success, but only increase its probability. There is, therefore, a risk that policies undertaken at great economic or political cost may generate no return. Furthermore, some risks are difficult to determine with any degree of confidence; for example, the effect changes in Canada's safeguard policies may have on the risks of nuclear proliferation. The remainder of this section discusses specific options for enhancing export performance.

9.2 MACHINERY OF GOVERNMENT

As indicated in section 4.2, the government plays an active role in regulating the activities of the Canadian nuclear industry in foreign markets. First, overall government approval is required for nuclear co-operation with any potential foreign customer as part of Canada's non-proliferation policies. Second, there are a number of specific approvals required, such as Treasury Board approval of negotiating parameters, before AECL begins the bargaining process with a potential customer. These contract approval procedures were developed in response to problems experienced by AECL in Argentina and Korea. They are designed to ensure that risks are minimized, returns are acceptable and sound business and financial practices are observed.

While the current machinery of government provides strong government control over the activities of the industry in general and AECL in particular, it has a number of important drawbacks. First, AECL's ability to respond quickly to changing circumstances in export markets is reduced. Second, it must be recognized that exports of nuclear reactors will continue to involve significant levels of commercial risk which even the most careful review process cannot eliminate. Third, the approval process tends to divert responsibility away from the Board of Directors and staff of AECL upon whose skills and efforts successful negotiation and completion of export contracts ultimately depends. Finally, the process requires a significant commitment of time and effort by Ministers, Officials and AECL.

A relatively straightforward option, therefore, is to attempt to streamline the machinery of government while maintaining adequate controls to ensure that government policy with respect to nuclear co-operation with foreign countries is observed. This could involve, for example:

1. Maintaining overall approval for nuclear co-operation with a potential foreign government as required by current non-proliferation policies;
2. Modifying contract approvals processes; and
3. Instituting a reporting process by which AECL, at the time a contract is concluded, reports details of terms and conditions to the Treasury Board. Further, the corporation would be required to provide to the Board an update of progress with each contract every 6 months.

This proposal has a number of advantages. While the government clearly maintains its primary role in establishing the policy framework under which exports take place, responsibility for carrying out commercial relations would be left with AECL. The reporting requirement would ensure that the government was kept aware of any possible financial implications arising from AECL's negotiation and management of contracts AECL would therefore achieve additional flexibility of operation, while the government maintains an effective degree of control.

Such a policy, while it would be welcomed by AECL and the industry and would impose no direct financial cost on the government, may not affect AECL's probability of success in foreign markets to an appreciable degree. It is likely that much more controversial policy changes would be required to significantly enhance sales prospects.

9.3 SAFEGUARDS

Canada's safeguards requirements are the most stringent among those countries which export nuclear reactors. In addition to acceptance of full scope safeguards on all its nuclear facilities and a binding commitment to non-proliferation, Canada requires importing countries to conclude a bilateral agreement imposing additional conditions.

Among Canada's major competitors for reactor sales, only the United States imposes a safeguards policy of almost similar stringency. U.S. policy does, however, allow more discretion in application, so that requirements can be adapted in special cases. This allows more flexibility in dealing with foreign customers and is the basis for U.S. dealings with India and Argentina.

Two other major competitors, France and Germany, require only the minimum set of safeguards established by international agreement. This confers a significant advantage from a commercial point of view.

Safeguards policies do limit the ability of the Canadian nuclear industry to sell abroad. Sales to Mexico, Argentina, Yugoslavia and China are clearly made more difficult by safeguards requirements. Among the most difficult policy decisions facing the government, therefore, is to what extent, of any, safeguards policies should be altered to improve Canada's ability to sell in foreign markets. Several options are available.

First, Canadian safeguards policies could be left unchanged, while Canada continues to seek upgrading of the safeguards policies of other governments. This has a number of advantages. If successful, it would result in a significant upgrading of international safeguards, while at the same time eliminating the advantages enjoyed by Canada's competition—particularly France and Germany. The major disadvantage is that it is a long term policy. Negotiations stretching over a period of years would be required. Even if it were successful eventually, the result would come much too late to help the industry out of its immediate difficulties.

Second, safeguards policies could be left unchanged, but applied somewhat more flexibly in practice. This would put Canada in a position similar to that adopted by the United States. Safeguards policy, as currently defined, does not allow for flexibility of application along U.S. lines.

Such a policy would have several advantages. It would allow increased flexibility to the industry in dealing with foreign countries which, for whatever reason, appear to warrant special treatment. Further, the incorporation of greater flexibility would not be a dramatic policy change so that risks are low in terms of public acceptability. At the same time, however, flexibility implies a discriminatory policy which can often create as many problems as it solves.

A more significant step would be to alter 1974 policy by limiting bilateral requirements to those specified in the 1978 NSG agreement. This would eliminate, with respect to bilateral agreements, any competitive advantage enjoyed by France and Germany, who currently adhere to the NSG guidelines. The problems with implementing this approach are three-fold: first it would affect the general credibility of Canadian safeguards policy development over the past decade; second, it would require renegotiating existing bilateral agreements, which could be diplomatically awkward. Third, rumored changes of this magnitude in Canadian policy could delay project negotiations with potential clients for whom the prospect of less demanding safeguards may be worth waiting. Further, while such a change in policy would be considered "significant" in the international community, it is not clear that the difference between Canada's 1974 policy and the NSG requirements is large enough to materially alter the probability of reactor sales.

More far reaching changes are conceivable. Canada's 1974 requirement for a bilateral agreement could be eliminated entirely, while maintaining the 1976 policy (full scope safeguards and a binding commitment to non-proliferation). This would increase the probability of sales to those countries which object in principle to bilateral agreements (Mexico, Yugoslavia). However, such an option would present a number of drawbacks. First, as a member of the Nuclear Suppliers Group, Canada is committed to implement the safeguards provisions agreed to by the NSC in 1978. Such a change in Canadian policy would require violating an international agreement which Canada was instrumental in achieving. Second, it would be seen as, and in fact constitute, a significant retreat from Canada's commitment to non-proliferation objectives. Third, it is not clear that such a policy change would significantly enhance sales prospects—the 1976 policy would still be more stringent in some ways than French and German requirements. Fourth, it may be possible to accommodate countries which object in principle to bilateral agreements by other means—e.g., back-to-back agreements with the IAEA following the U.S./Yugoslavia model.

Even if the requirement for a bilateral agreement were eliminated, Canada would remain at a competitive disadvantage in a number of countries (e.g., Argentina) with France and Germany, neither of which require full scope safeguards. The most dramatic change Canada could make, therefore, would be to abandon full scope safeguards and impose only those safeguards conditions required by the NSG international agreement. This would totally eliminate this aspect of competitive advantage enjoyed by other suppliers in the international market place. A fundamental drawback is that such a policy would mark a retreat from the entire thrust of development of Canadian safeguards policy since 1974. Despite arguments that countries can always buy nuclear technology from France or Germany anyway, such a policy could increase the risks of nuclear proliferation. A repeat of Canada's 1974 experience with India could not be ruled out.

9.4 POLITICAL EXCLUSIONS

Current Canadian government policy precludes nuclear co-operation with a number of countries: South Africa, the middle east and Taiwan. These exclusions affect the size of the reactor market open to AECL. Other exclusions—for example, the U.S. military program—primarily affect the size of AECL's heavy water market.

One policy option, therefore, is to modify Canada's exclusion policies. As far as reactor sales are concerned, the most important market which could be opened up by changing exclusion policy is Taiwan. Nuclear co-operation between Canada and Taiwan would require a bilateral safeguard agreement between governments, as well as involvement of both AECL and the EDC. However, Canada's 1970 recognition of the People's Republic of China rules out government relations between Canada and Taiwan, including transactions carried out by crown corporations.

Gaining access to the expanding market in Taiwan poses difficult problems. Canada could, for example, informally sound out the Chinese government for its potential reactions to a Canadian marketing initiative. Another possibility would be to drop requirements for a bilateral agreement in the case of Taiwan, or to use the U.S./Taiwan agreement as an umbrella. This, however, still leaves the government involved through AECL. Third, a revision of Canada's 1970 agreement with China could be sought.

9.5 FINANCING

Financing is another area in which Canada is at best just competitive with some of the alternative suppliers. In many cases, Canada is at a competitive disadvantage. The Export Development Corporation, which undertakes reactor financing, views itself as a commercial entity which provides funds on terms and conditions which cover its own costs of borrowing. Concessional interest rates are partly counter balanced by service charges which EDC imposes on AECL and which AECL, in turn, passes on as a cost to customers. This limits the extent to which AECL can compete with countries which provide concessional financing as an overall export promotion policy. Further, given the size of EDC's annual signing, the scope for handling an increase in reactor sales is limited.

Changes have recently, been approved in export financing policy. New provisions allow case by case consideration by Cabinet of major project financing which exceeds EDC's normal capability. While this improves prospects, it does not guarantee availability, which may impose a constraint on negotiating export contracts.

Policy now allows EDC to finance about $300 million per year as "crédit-mixte", of which $100 million would be at a rate of 3% and $200 million at the normal EDC rate.

This amount, however, is insufficient for even one reactor sale; and, in any case, the funds will most likely have to be spread over a number of different export projects.

Further improvements in financial assistance are a policy option open to the federal government. These could include:

Guarantee of financing at concessional rates for foreign sales.

Availability of "crédit-mixte" for reactor exports to countries qualifying for Canadian aid which have been offered crédit mixte financing by competitors.

This policy has a number of advantages. It would improve immediate sales prospects in key market: Korea and Mexico. These are sales which are critical to the industry at a time of over capacity. Second, it involves no dramatic change in Canadian policy, merely an improvement in terms and conditions consistent with an overall policy of promoting Canadian exports.

The main drawback is expense. EDC estimates that a 1% reduction in interest rates is equivalent to roughly a $30 million reduction in selling price. Thus meeting "crédit-mixte" terms (5 to 6% per annum to countries which quality) offered by competitors may involve subsidies equivalent to 25 to 30% the cost of a reactor sale. The implicit subsidy involved in competing with concessional financing (as opposed to crédit-mixte, which involves a foreign aid component) would be somewhat less costly.

While the costs of concessional financing are large, such expenses are only incurred if sales are successfully concluded. With policies such as an increased marketing effort, expenses are incurred regardless of the ultimate effect on sale.

9.6 MARKETING

Canadian marketing efforts in the past have been inadequate. In part, this is a consequence of Canada's small size in relation to its competitors. In part, however, it has been caused by lack of a coherent market strategy; a failure to identify key contacts; an apparent inability to deliver adequate amounts of information to decision makers on time; and an approach that emphasized the technological superiority of the CANDU system while paying insufficient attention to key non-technological factors. The role of government in restricting AECL's activities in some markets is also a factor.

AECL and the nuclear industry have now moved to corrrect some of these problems to the extent they are within their areas of influence. Creation of AECL International is part of a corporate effort to improve its marketing strategy and practices. Closer co-operation in marketing efforts between AECL and the Organization of CANDU Industries is reducing problems associated with fragmentation of the Canadian Industry.

Important decisions, however, are still required. A broad sustained marketing effort is costly. One policy option, then, is to increase funding of AECL's marketing activities. The drawback here, however, is that, given soft export markets and intense competition, there is no guarantee of success. Increased funding will increase the *probability* of a sale, but the possibility of no return at all remains real.

Another important question in key markets is the use of local agents and the payment of agents' commissions. Canadian policy with respect to agents arises out of the controversy surrounding AECL's relationship with local agents in Korea. This resulted in a 1976 policy statement which required that subsequent dealings with local agents be covered by comprehensive written agreements; and further, that no practices be allowed which be illegal in the importing country, or would be illegal if they were undertaken in Canada.

The use of local agents and payment of agents's fees is a prerequisite to success in some important markets. Such arrangements, however, could contravene the letter or the spirit of the 1976 policy statement. This leaves two policy choices: observe the 1976 policy to the letter and lose a sale; or modify the 1976 policy (or interpret it more flexibly) and conclude a sale.

9.7 CONCLUSIONS

There are a number of policy options available to the government which might improve Canada's performance in foreign markets. These vary widely in terms of degree of difficulty, cost and potential benefits. At the simplest level AECL could be allowed more commercial freedom to pursue export sales. While this option has few costs in financial or public acceptability terms, it is unlikely to improve sales prospects in any significant way. More difficult and sensitive options are changes in Canada's safeguard requirements. While such changes may improve sales prospects, they are high risk options in political and public acceptability terms. Another option is to improve terms under which reactor sales are financed. This is an attractive option in the sense that costs of concessional financing are only incurred if a sale is concluded. On the other hand, the implicit subsidies involved in concessional financing are high and would have to be financed by appropriations from the CRF.

In sum, export markets are soft and the competition fierce. Policies which would significantly improve Canadian sales performance generally involve high risks and high costs. Even with strong policy action, there is no assurance of success—the probabilities of success are simply improved. The government, therefore, is faced with extremely difficult decisions—to take a high risk course of action, the benefits of which are uncertain, or to accept the consequences for the Canadian industry of taking no action at all.

The next section discusses the laissez-faire, or do nothing option, in detail.

10. A Laissez-Faire Policy

A laissez-faire option is attractive because it avoids the economic, financial and public acceptability costs of an active policy.

Previous sections have made it clear that there are no easy solutions for the industry's problems. Policy options to improve the domestic outlook for the industry are limited. A dedicated exports option is attractive in many respects, but may be constrained by institutional factors and involve high costs in terms of public acceptability. The export market is weak and very competitive—big improvements in the outlook for reactor exports would require tough decisions on safeguards, political exclusions, financing and marketing, with no guarantee of success. A real possibility exists that policies which are costly in both economic and public acceptability terms would produce little improvement in the industry's prospects. A laissez-faire policy avoids these risks.

Against these avoided costs, the consequences of a laissez-faire option for the domestic nuclear industry and the maintenance of the nuclear option must be weighed.

There is a risk that large segments of the nuclear industry could be dismantled in the latter half of the 1980's. This implies if load growth continued in the 1990's, that (1) Canada would have to simply do without nuclear power (2) nuclear technology would have to be imported from abroad or (3) the Canadian industry would have to be reassembled. This section examines these three alternatives.

(i) *Doing without Nuclear Power*

The alternatives to the CANDU as an electricity source are hydro, coal, and imported nuclear systems. In Eastern Canada, the available economic hydro sites will largely be developed by the end of the century. In Ontario, there are virtually no large economic hydro sites left even now. Nuclear power is already cheaper than coal in this region[1] and its economic advantage will increase. The cost of doing without the nuclear option would thus include higher costs in economic, social and environmental terms of resorting to less efficient alternatives, as well as lost industrial and technological benefits.

(ii) *Importing Technology from Abroad*

Because the design and the content of the CANDU is Canadian, it offers industrial benefits that an imported reactor could not match. It provides desirable highly skilled employment. It represents a stimulus to a wide range of research, development, and other high-technology activities in Canada: instrumentation, quality assurance, design engineering, etc. If reported reactors were used in Canada, these activities would be carried out in the vendor countries' laboratories and workshops.

If Canada were to import light water reactors from another country, many of these industrial and trade benefits would be lost, along with a certain degree of energy security.

Of course, not all the jobs in Canada's nuclear industry would disappear. Many of the construction and installation jobs would remain, and some components would surely be manufactured here. As long as the buyers market for nuclear reactors continues, Canada would be able to negotiate industrial benefits; some fraction of the costs could be guaranteed spent in Canada; technology transfer could be arranged; branch plants could be set up for some components, some of which might even obtain world product mandates.

In return, Canada would have the advantages of adopting a reactor system used all over the world, with the attendant economies of scale, competitive sourcing, and benefits of widely shared experience. However, since the CANDU already performs better than the LWR, it seems difficult to imagine that these benefits would compensate for the advantages Canada would lose by being a consumer rather than an innovator.

(iii) *Exit and Reassembly*

If demand for CANDU units increases at a later date, the industrial capability could in principle be revived. Ontario Hydro would continue, the designs would still exist. This scenario is possible, but it overlooks several factors. One is that even if designs exist on paper, advanced technology depends on the skill and motivation of highly trained people working in teams. The skills to design and build complex equipment like the CANDU fueling machine are acquired over many years. Once the teams are dispersed and people have involved themselves in other activities, it is hard to put them back together. New teams just be assembled and new people trained. Also both people and companies would have to be motivated to return to an activity which had foundered once before. It will be hard to reestablish the confidence necessary to rebuild an industry which had been allowed to lapse. Finally, technology does not stand still. Other reactor designers and builders in the world will be working steadily through the early part of this decade, gaining experience, improving their design and procedures, and establishing consumer confidence.

Again, these are prospects to which a degree of uncertainty is attached. The sales scenarios used in this paper are simply possibilities. If things went unexpectedly well for the industry, it is always possible that no commercial problems would occur, even in the absence of an active policy.

In summary, a laissez-faire policy would avoid the costs inevitably involved in taking positive action with respect to the nuclear industry. It would, however, also involve some costs. On the one hand, these include costs of adjustment imposed on the industry to meet demands in the 1990's. More generally, however, a laissez-faire policy also involves foregoing the benefits an active policy would generate: profits for the industry, foreign exchange, employment and technological spill overs.

11. SUMMARY

From 1964 to 1978, the Canadian nuclear industry sold 24 reactor units (including research and power reactors), an order rate of almost 2 units per year. In contrast, since 1978, there have been no firm orders. The industry is therefore facing an indeterminate period of excess capacity, its future clouded by uncertainty regarding the timing and magnitude of the next round of orders.

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[1] Estimates prepared within the Department indicate savings of approximately $700 million ($1980) per 850 MWe reactor unit over coal over a 30 year lifetime.

The outlook for the industry depends upon its domestic and export sales prospects.

11.1 DOMESTIC MARKET

Most provincial utilities currently have excess capacity and will require few additions to capacity beyond those currently under construction, for a decade or more. However, most forecasts indicate that new generating capacity will be required in the 1990's. Nuclear energy is an economically attractive option for meeting part of this load growth. Because of long lead times, orders will need to be placed in the 1980's for capacity additions required in the 1990's. The big uncertainties are the number and timing of future nuclear orders, in relation to the nuclear industry's capacity.

The market for CANDU in Canada will be confined to Ontario, Quebec and the Maritimes. Depending on the coal/nuclear mix chosen by the province and the rate of electrical demand growth ultimately realized, Ontario could choose to build no new reactors beyond Darlington, relying entirely on coal, or decide to meet load growth exclusively with nuclear energy and require as many as nine post-Darlington reactors to the year 2000.

In Quebec the outlook is even more uncertain. Forecasts of electricity demand growth vary more widely for Quebec than for any other province. In addition, Quebec has a number of remaining hydro sites which can be developed, at varying degrees of expense. Thus, an important uncertainty is the extent to which provincial government policy may override economic considerations and promote the development of non-economic hydro in order to maximize the development of indigenous provincial resources.

The minimum Quebec program is no additional nuclear development to the year 2000. On the other hand, if nuclear power is politically acceptable, and load grows at rates predicted by Hydro Quebec, as many as 12 reactors might be required by the year 2000, assuming the province develops only those hydro sites economically competitive with nuclear energy.

The Maritimes are also a potential market with a second LePreau reactor a good possibility sometime in the 1980's.

The range of uncertainty is, therefore, large. It is arithmetically possible that as many as twenty reactor units may be required to meet domestic load growth this century. More realistically, from zero to seven reactor units will likely be required, coming on stream in the 1990's. If the upper end of this range were realized, it should be possible to sustain a rationalized industry.

What is certain, however, is that the situation over the next few years will be critical for the industry. Given excess capacity being experienced by domestic utilities, domestic orders in the early to mid-1980's, will likely be non-existent on the basis of the domestic market alone. Virtually all firms in the industry could be out of business by the mid-to-late 1980's thereby foreclosing the capability of the industry to meet the next round of orders in the late 1980's.

Under these circumstances the export market over the next few years becomes extremely important because it offers the best prospect of a nearer term sale which would reduce somewhat the industry's short term problems of excess capacity.

11.2 THE EXPORT MARKET

Export markets will be soft for at least the next decade and perhaps to the end of the century. Competition is strong and other producers are also motivated by excess capacity in their domestic markets to pursue export prospects.

Despite these difficulties, an export market does exist and CANDU possesses features which will continue to make it attractive to many countries. Romania, Korea and Mexico are the best near-term prospects, with other opportunities concentrated in the latter part of the 1980's.

While the export sector will not likely sustain the nuclear industry in the long run, one or more near term sales will be critical to maintaining the industry into the mid-1980's, at which time the outlook for domestic sales in the 1990's should be much clearer.

11.3 THE POLICY QUESTION

Given the outlook both domestically and in export markets, a fundamental question posed in the paper is whether the nuclear industry in Canada will survive the 1980's in order to serve a probable—but far from certain—domestic demand for nuclear energy in the 1990's; and what, if anything, the government should do to sustain the industry. In order to answer this question, the paper briefly examined the consequences of allowing the industry to disband over the next few years.

In this case, to meet load growth in the 1990's, Canada could (i) do without nuclear power (ii) import light water technology from abroad or (iii) reassemble the industry. All these options involve significant costs and risks.

The first forgoes the economic and industrial benefits of maintaining a generating technology which is already considerably less expensive than coal. The second involves the loss of the industrial spin-offs, high technology employment and energy security benefits of an independent CANDU option. The third imposes the economic costs of reassembling the industry along with the risk that such an alternative may ultimately be infeasible in technical and economic terms.

While more quantitative analysis of these options now needs to be undertaken, it appears sensible at this point to pursue policy options which will maintain the nuclear option for the next few years, at which time new orders for reactors to come on stream in the 1990's should begin to be placed. However, it is also possible that the domestic and export outlook will not improve, and the same problem will have to be faced once again in several years.

11.4 POLICY OPTIONS

Export Markets

The export market offers the best prospect for a near term sale. Policy options with respect to export sales are therefore particularly important. At the simplest level, AECL could be allowed more commercial freedom to pursue export sales. More difficult and sensitive options are changes in Canada's safeguard requirements. While such changes may improve sales prospects, they are high risk options in political and public acceptability terms. Another option is to improve terms under which reactor sales are financed. This is an attractive option in the sense that costs of concessional financing are only incurred if a sale is concluded. On the other hand, the implicit subsidies involved in concessional financing are high and would have to be financed by appropriations from the CRF.

Domestic Options

While scope for policy action in the domestic market is limited, some positive steps are possible. The most promising options for improving the industry's prospects in the short run are policies aimed at achieving an early commitment by Quebec and New Brunswick to Gentilly-3 and LePreau 2 respectively.

Constructing reactors for power export could generate attractive economic returns and, in addition, provide badly needed business for the Canadian nuclear industry at a time of over capacity.

[From the Globe and Mail, June 2, 1981]

WITH OR WITHOUT AID, A-INDUSTRY IN TROUBLE: REPORT

OTTAWA (CP).—A Government report says federal options for the country's hard pressed nuclear industry range from promoting reactors in some provinces—at the risk of higher electricity rates—to avoiding difficult decisions with a hands-off policy.

A copy of the report's conclusions, not yet released, was obtained yesterday by The Canadian Press.

An internal review of the ailing industry was ordered more than a year ago by Prime Minister Pierre Trudeau. Energy Minister Marc Lalonde has promised to release at least some of the background studies contributing to the report, but has made no commitment on the report itself.

A draft version of the review, carried out largely by civil servants with help from consultants' reports, was circulated among federal departments on May 15. It offers a gloomy outlook for domestic and export reactor markets without dramatic federal action. The industry hasn't had a firm order since 1978.

"Virtually all firms in the industry could be out of business by the mid-to-late 1980s, thereby foreclosing the capability of the industry to meet the next round of orders in the late 1980s," the report says.

It suggests a stepped-up domestic program, with Ottawa offering more attractive incentives, especially in New Brunswick and Quebec, where provincial utilities have minimal nuclear programs compared with Ontario's.

It also suggests promoting export sales with a more flexible marketing effort that might ease Canada's safeguards against nuclear weapons proliferation and make more use of public money for financing sales.

But the report, which outlines Ottawa's options without specifying which to take, also suggests the industry could be left to wither. "A real possibility exists that policies which are costly in both economic and public acceptibility terms would produce little improvement in the industry's prospects. A laissez-fair policy avoids these risks. . . . It would, however, also involve some costs."

These costs include relying on hydro power and coal to generate future electrical needs, importing technology if more reactors are decided on in the future or trying to revive a high-technology industry.

Such a policy would rob Canada of profits, foreign exchange, employment and technological spinoffs, the draft says.

The report says building reactors in anticipation of future need would eventually mean cheaper electricity, but domestic rates could increase in the short term to cover high construction costs.

Swelling reactor capacity could mean export sales to the United States, the report says. But that market would disappear around the end of the century when U.S. utilities catch up with the growth in demand.

"Canadian consumers and taxpayers would then bear the costs of the excess capacity."

The export market is intensely competitive and Canada's track record against the United States, West Germany and France, the other countries exporting reactors, has been unimpressive. "This means, for example, that devoting more resources to international marketing or altering safeguard policies will not assure success, but only increase its probability. . . . The Government, therefore, is faced with extremely difficult decisions—to take a high-risk course of action, the benefits of which are uncertain, or to accept the consequences for the Canadian industry of taking no action at all."

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